VOL. XVI. No. 10 OCTOBER 1931

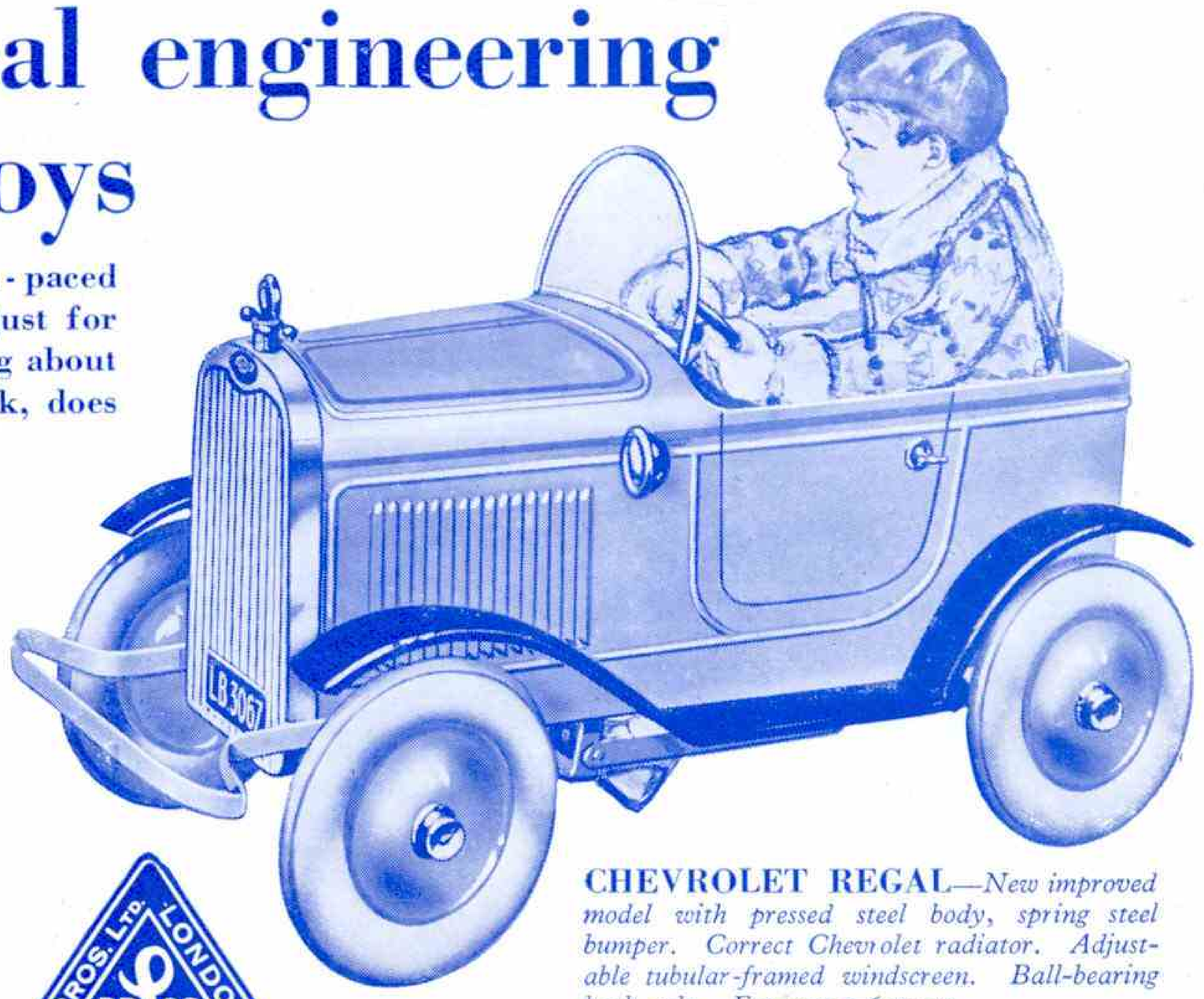
MECCANO MAGAZINE

PAINTING A GREAT BRIDGE
(see page 770)

6D.

There's real engineering in these toys

Tri-ang Toys are thorough-paced engineering jobs. Made not just for show, but for work. Everything about them that can be made to work, does work. For their makers, Lines Bros. Limited, very well know that nothing less than that is enough for the stern young realists of the rising generation. Consider these cars, for instance. Pressed steel bodies, adjustable windscreens, ball-bearing back axles, half-elliptic springs—bonnets that open, lamps that light: isn't this the sort of thing the young idea talks in his sleep about? Get in touch with the Tri-ang agent and hear all about the whole Tri-ang range.



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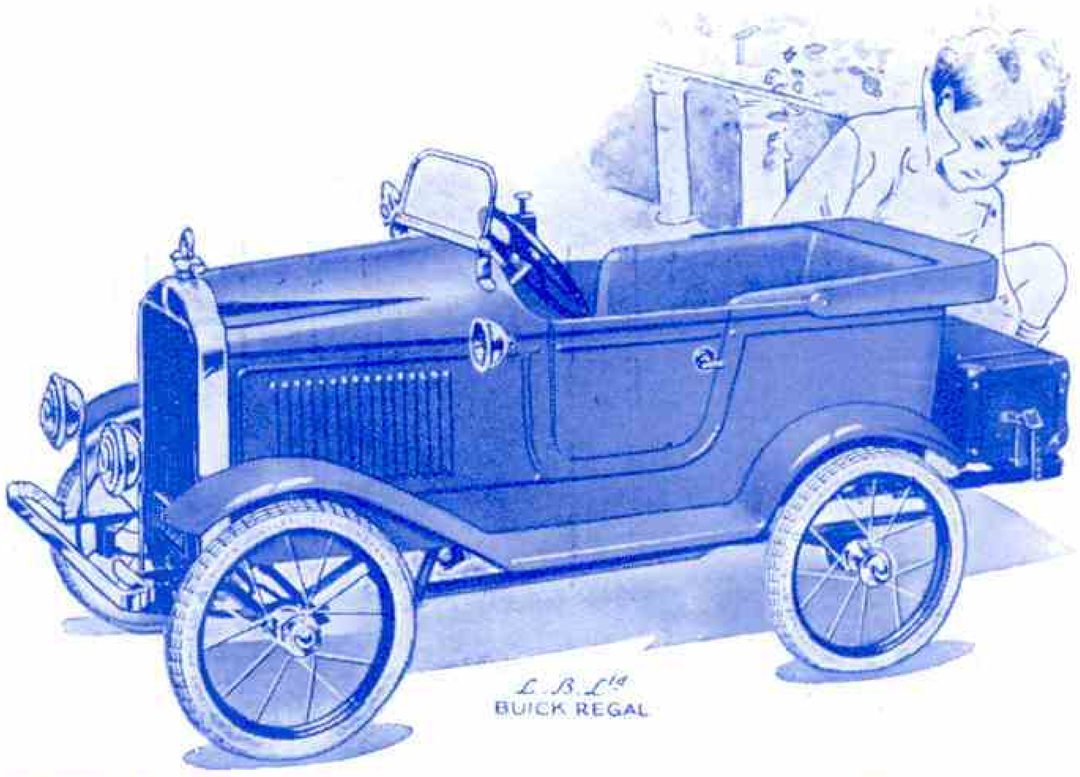
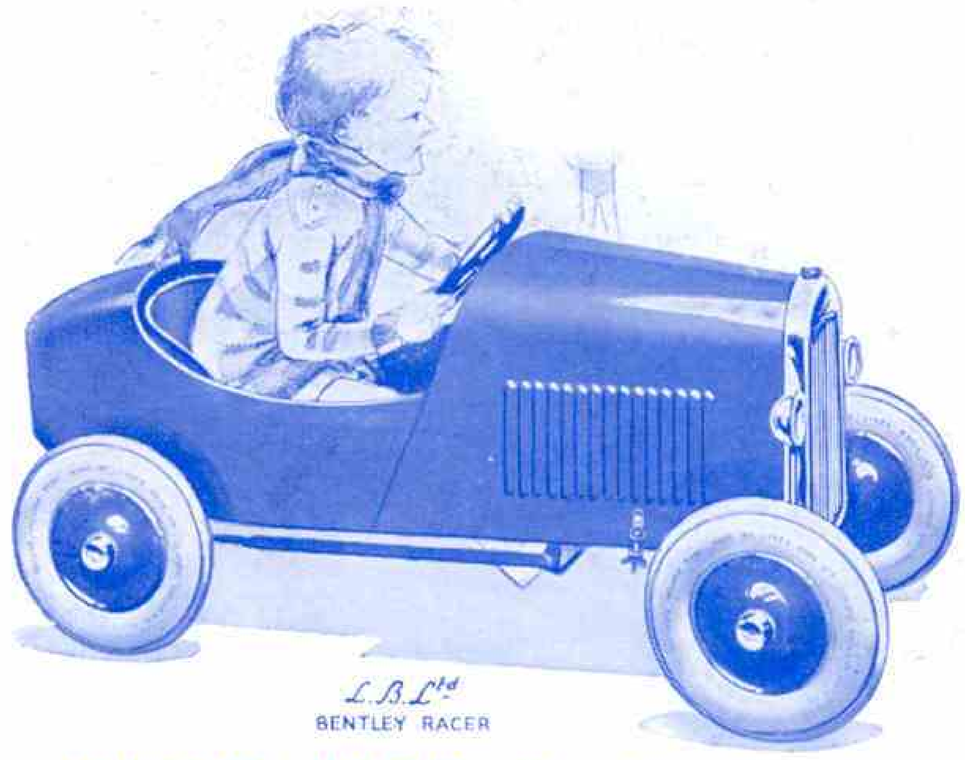
CHEVROLET REGAL—*New improved model with pressed steel body, spring steel bumper. Correct Chevrolet radiator. Adjustable tubular-framed windscreen. Ball-bearing back axle. For ages 3-6 years.*

CHEVROLET MAJOR *is longer. For ages 4-8 years.*



BUICK REGAL—*Pressed steel body on half-elliptic springs. Ball-bearing back axle. Adjustable tubular-framed windscreen. Fitted for two electric lights.* $1\frac{1}{16}$ *in. white auto tread tyres on tangent spoked wheels. Luggage grid and trunk. For ages 4-8 years.*



BENTLEY RACER—*All steel body, lift-up bonnet. Adjustable seat. Plated model Bentley radiator.* 9 *in. steel balloon wheels,* $\frac{5}{8}$ *in. rubber tyres. Rubber pedals. For ages 3-6 years.*

BENTLEY RACER MAJOR *is longer. For ages 4-8 years. Ball-bearing back axle,* 11 *in. balloon wheels.*

Lines Bros. make these all-metal toys—tip lorries, wagons, vans, breakdown lorries, airplanes, doll's prams, cranes, barrows, fairycycles, Tri-ang (regd.) cycles and tricycles, scooters, pedalkars, etc., etc.

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NEXT MONTH: "ENGINEERING IN ANCIENT EGYPT." PUBLISHING DATE: 31st OCTOBER

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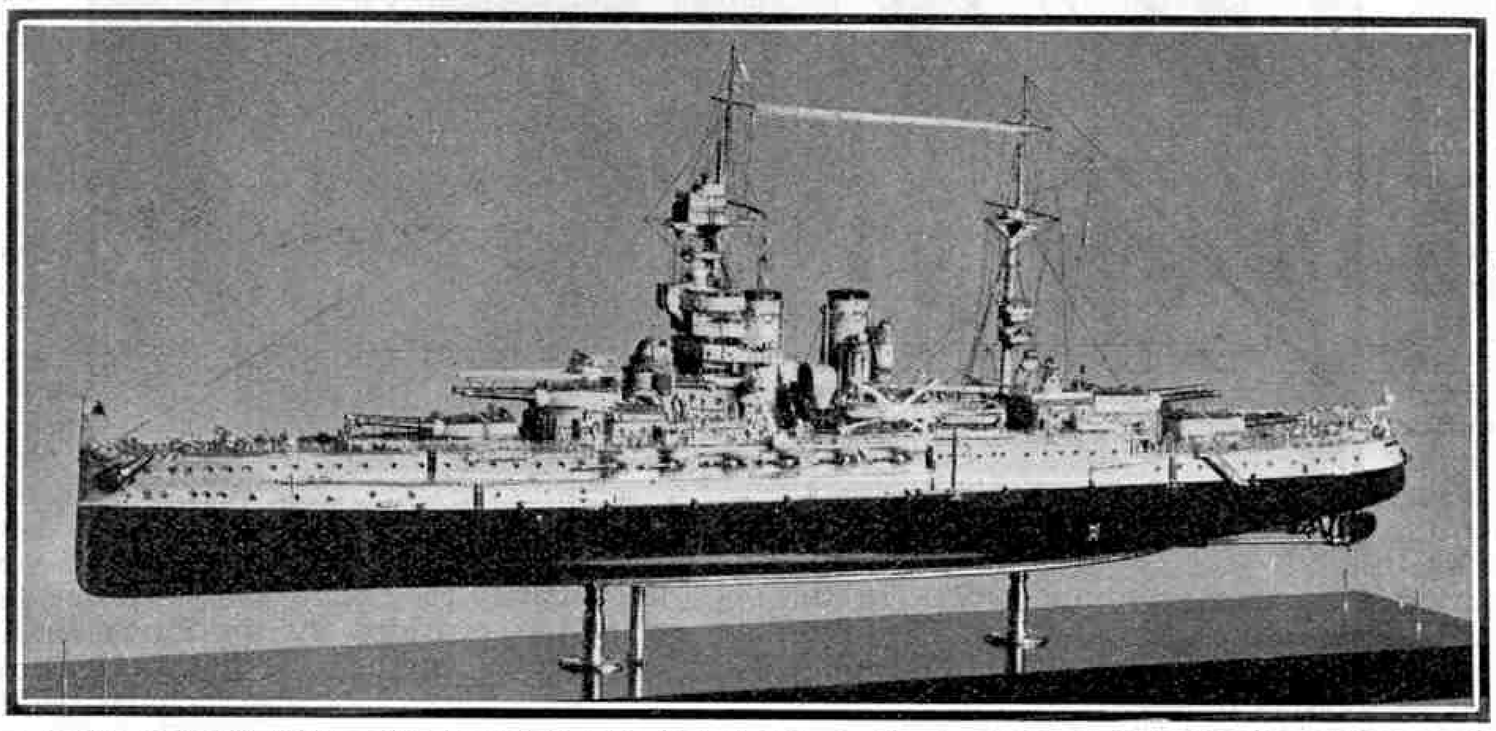
With the Editor

Ship Models through the Ages

One of the most interesting features of the "Shipping Week" held recently in Liverpool was an exhibition of ship models held in the great St. George's Hall. The object of this exhibition was to show how the modern ship has been developed from the quaint craft used in the earliest times of which we have any record. The exhibits served another purpose, however, and that was to show how ancient is the art of model-building.

There is something intensely fascinating about the models—unfortunately few in number—that have been preserved to us from the dim past. Take, for instance, a model of a boat found in an ancient Egyptian tomb. In looking at it our thoughts inevitably go back to that forgotten craftsman working away patiently at his model, 2,000 years ago or more. We wonder what kind of man he was, what his workshop was like, and what tools he used. Of one thing we can be certain, and that is that this ancient worker was filled with the same enthusiasm for his creation as is the keenest model-builder of to-day. One feels regret that he cannot know how reverently we cherish his little boat.



A model of H.M.S. "Queen Elizabeth," Earl Beatty's flagship in the Great War, built by Mr. Gerald S. Rees of Nelson, British Columbia, Canada.

Many of the most ancient ship models we possess were built for religious purposes. The Egyptians placed in the tombs of their kings and nobles models of sailing ships to enable the dead to navigate the waters of the underworld. These were often accompanied by models of funerary boats that were to convey the souls of the dead. But whatever the purpose for which the ancient models were intended, they show that the fascination of miniature representations existed then as it does to-day. It is this fascination that impels the model-builder to labour at whatever piece of work he has in hand until it is perfect in every detail. To the real enthusiast time counts as nothing. He is prepared to devote his spare moments for weeks, months, or even years to the completion of one particular model—and then he starts another!

I well remember a magnificent model of a passenger liner that attracted my attention at an exhibition. The feature that struck me most was the saloon furniture, all perfectly made to scale. The builder told me that he completed the ship itself in about a year, but the making of the miniature furniture took him more than three years, as the pieces were so small and fragile that they broke in his hands time after time.

A typical model of this kind is illustrated on this page. It represents the "*Queen Elizabeth*," Earl Beatty's flagship in the Great War. It measures 40 in. in length, and is electrically lighted. It was built with ordinary household tools, without a lathe, and its construction occupied a total of 700 hours' spare time!

London in Floodlight

The floodlighting of large buildings by means of the rays from giant searchlights has become increasingly popular in the United States during the past few years, but little has been done in this direction in the British Isles. Last month, however, London, and to a smaller extent certain provincial towns, were afforded for a brief period a striking example of what floodlighting means and what it can do. The scheme was carried out in connection with the International Illumination Congress, which was then being held in London, and incidentally it afforded yet another striking reminder of how much we owe to Michael Faraday for his discovery, a century ago, of the principle of the dynamo.

The remarkable thing about floodlighting is the manner in which it clothes with a strange attractiveness structures and scenes that are dull and commonplace by day; and of course where the scene is normally attractive its beauties are still further enhanced in the glow of the artificial light. St. Paul's Cathedral, Westminster Abbey and other familiar buildings took on an entirely new beauty when bathed in the floodlight, and an extraordinary effect was produced in St. James's Park by the floodlighting of the trees and flower beds. Mr. Clifford C. Paterson, President of the International Illumination Congress, urges us to try the effect of transforming our gardens into fairylands by floodlighting them, summer and winter, at an expenditure of current no greater than that of an ordinary electric radiator.

Perhaps the most brilliant spectacle of the London illuminations was that at Charing Cross, where two fire floats threw enormous jets of water into the beams of searchlights. The beauty of this scene made one long to see more displays of this kind. Readers will remember the photograph I published in the December, 1930, "*M.M.*", showing Niagara Falls illuminated by 24 searchlights, equivalent to 1,320,000,000 candle power! We cannot produce such a spectacle in this country, but there is no reason why some of our public fountains should not be illuminated on similar lines to many of those in the public parks of the United States.

This display of floodlighting was carried out voluntarily, and there was no public expense of any kind. Manufacturers, contractors, and supply companies, both electric and gas, provided equipment and service freely on an ample scale, because they regarded the display as a splendid advertisement for this country. In the words of Mr. C. C. Paterson, to whom we have just referred: "Floodlighting is one way of showing people from abroad what a beautiful city London is. The more attractive we can make England, and the more we can show our skill in technical things, the better it is for British industry, and the more visitors and the more trade we can attract here."

Preserving the World's Steelwork

The Thrills of Painting Giant Bridges

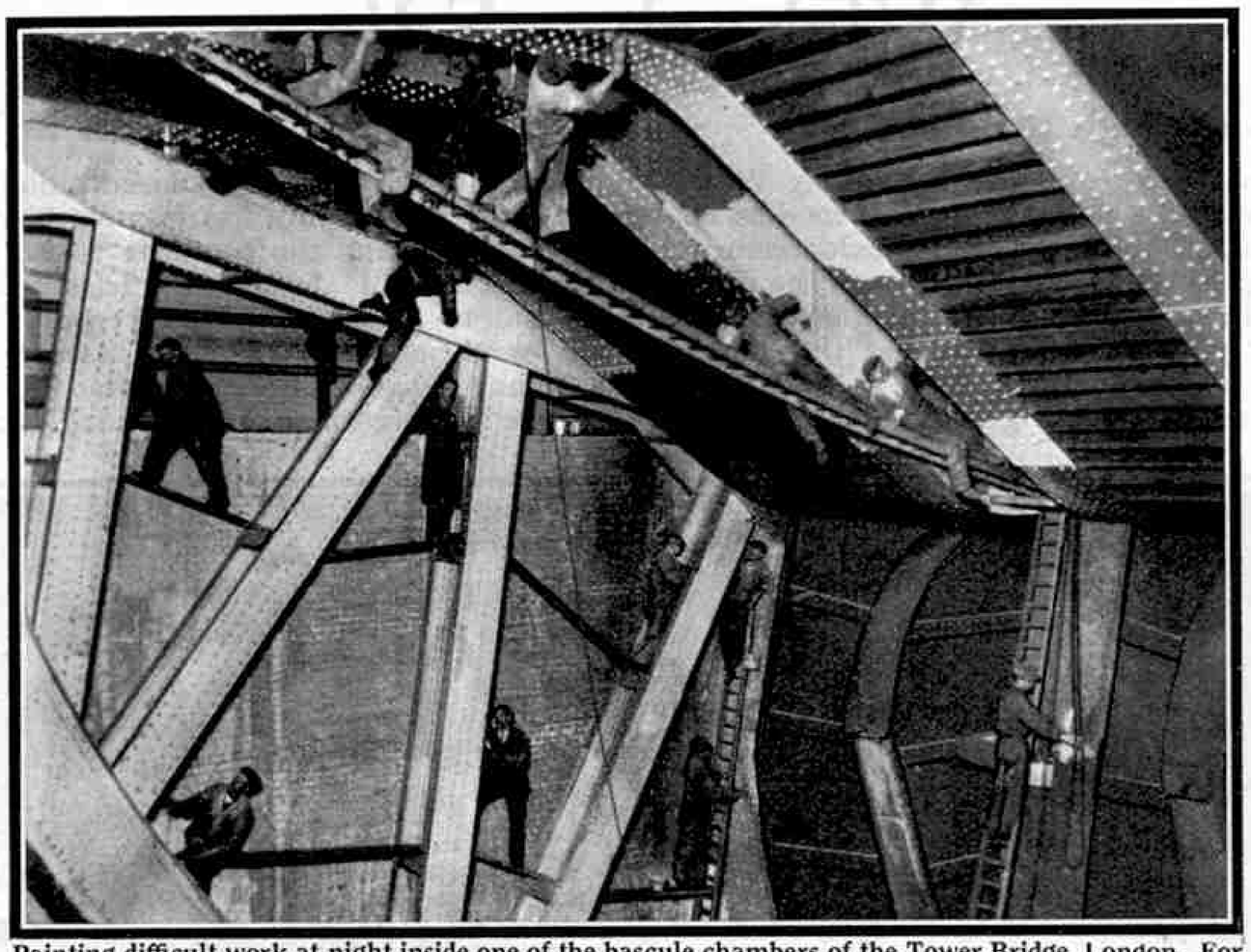
THE modern structural engineer requires a material that has great strength without weight, and that is more flexible and capable of being incorporated into a structure at a higher speed than either stone or brick. All these qualities the engineer finds in steel, and consequently this material is used to an enormous and increasing extent for structural work of all kinds.

It is unfortunate that iron and steel have one great weakness—they commence to rust or oxidise immediately they are exposed to the atmosphere. Iron is found in nature mostly in the form of an oxide, and after it is separated out it takes the first opportunity of returning to its oxide condition. If nothing were done to prevent it, all exposed ironwork and steelwork would rapidly decay and fall into ruin. The wastage from rust is much greater than most people realise. The famous metallurgist Sir Robert Hadfield, Bt., has estimated that the world loss of iron and steel through corrosion amounts to £500,000,000 per annum.

The difficulty of dealing with this corrosion lies in the fact that, once the rusting process has started, it goes on continuously. In this respect iron presents a remarkable contrast to lead. Although lead quickly begins to corrode under atmospheric influences, the process stops almost as soon as it has started. The first thin film of oxide that is formed acts as a protective layer that effectually prevents the atmosphere from continuing the attack. As a result there are still in existence lead water pipes that were laid down in Roman times.

For many years metallurgists have sought to perfect alloys of iron and steel that would be capable of resisting corrosion, and remarkable progress has already been made. Rustless iron and steel are now being produced in rapidly increasing quantities. Rustless iron is used for the wheel discs, shields and body work of motor cars; and for wire, seamless tubes, and utensils of various kinds. Rustless steel has proved specially valuable in the manufacture of turbine blades, in which resistance to corrosion and to the erosive action of high velocity steam is of very great importance. It is used extensively also in the manufacture of cutlery of all types, for fittings for shops and other buildings where good appearance is important, and for many other purposes. No doubt some kind of rustless steel will eventually come into use for all steelwork that is exposed to the atmosphere, but at present this is not practicable.

Experience has shown that the only method of securing ordinary iron and steel against corrosion is to coat the metal with some substance that will cling to it sufficiently closely to prevent the atmosphere from reaching it. This can be done in various ways, such as coating with tin by immersion in the molten metal, or by coating with zinc by galvanising; but for large masses of steel, such as are found in bridges and ships, the only protective method at present practicable is that of painting. For this purpose red lead paints are very suitable, and for a long time they were used almost exclusively for steelwork. During recent years, however, silica-graphite paints have become very popular for this work, and have now superseded red lead paints to a considerable extent. Bituminous paints are also employed, being generally applied as a finishing coat over silica-graphite paint.



Painting difficult work at night inside one of the bascule chambers of the Tower Bridge, London. For this illustration and those on the opposite page we are indebted to the courtesy of W. G. Beaumont and Son, London.

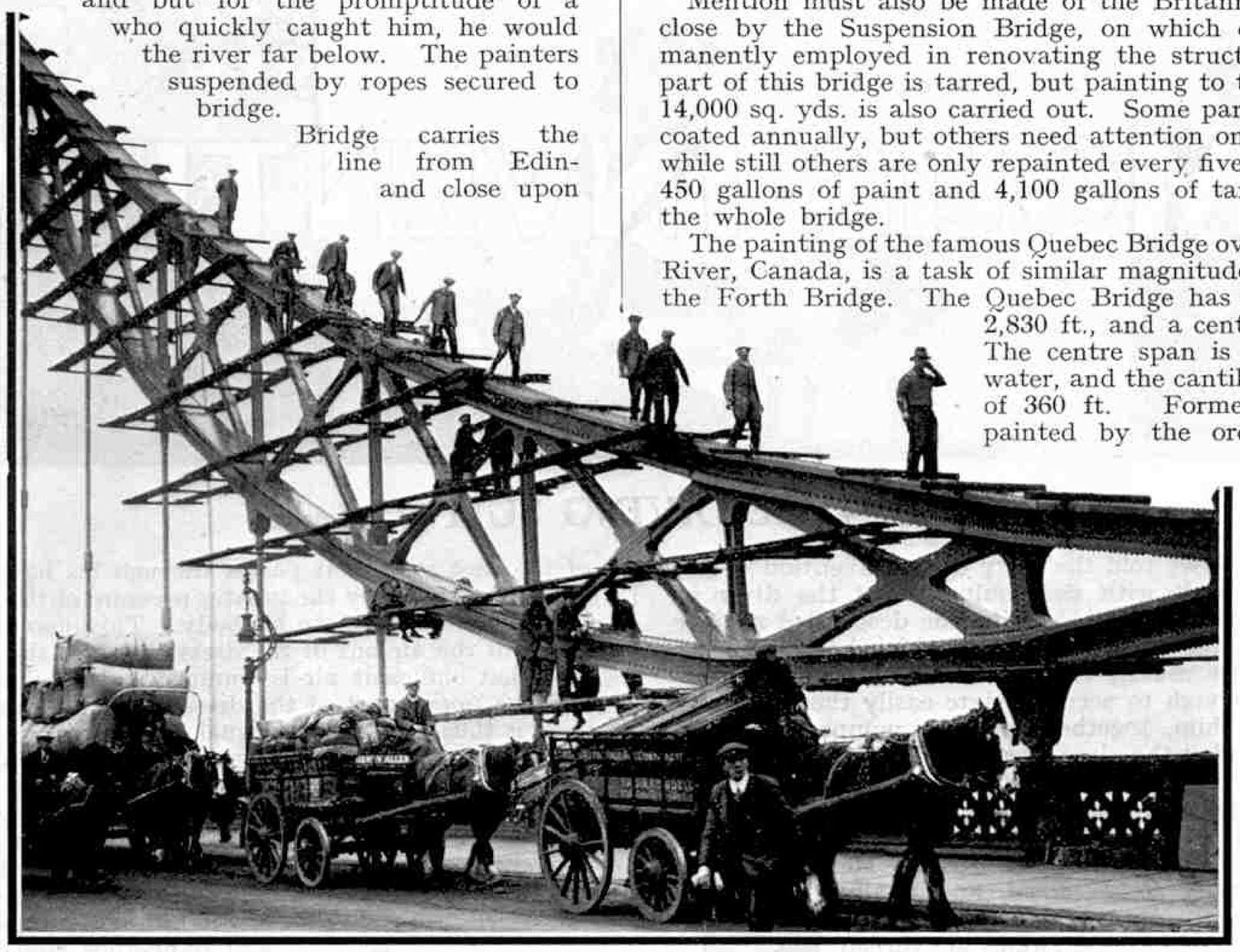
The protective efficiency of paint deteriorates after a time, and steelwork that is permanently exposed to the atmosphere must be repainted periodically so that the metal is always adequately covered. The painting of such a structure as a large bridge is a task of great magnitude, and in some cases a squad of painters are employed permanently on the work, commencing all over again immediately they have completed one painting. A good example of this is provided by the Forth Bridge. This great structure has a total length, including the approach viaducts, of 8,295 ft. and includes two large spans each 1,710 ft. in length, with a half span on each side, 695 ft. in length. The top of each cantilever is 360 ft. above the water. There is a clear headway of 150 ft. for a breadth of 500 ft. for vessels passing under the large centre spans, and a depth of water below the north span of 218 ft. The bridge contains 135 acres of steelwork that must be kept painted, and this colossal task takes three years to complete. The average strength of the painting squad is 30 men, and the amount of paint they use each year is about 18 tons, so that roughly 54 tons of paint are necessary to paint the whole of the bridge.

Courtesy [*Vickers-Armstrong Ltd.*

Painters at work on the side of a ship.

The work of painting a huge bridge calls for exceptionally steady nerves and a clear head, for a false step means almost certain death. When painting the upper portions of the Forth Bridge, the men climb to their work by way of a vertical stairway that is nothing more than a succession of wooden ladders lashed firmly to the steel struts. Familiarity with this jerry-looking stairway does not make the painters careless, but it cultivates self confidence, and the "old hands" climb it as calmly as they ascend the stairs in their homes. In spite of every care, however, accidents sometimes happen, and most of the workmen can tell thrilling tales of narrow escapes from death. On one occasion a painter was descending the ladder stairway when

a stranger, who had succeeded in getting on to the bridge unnoticed, shouted to him. The painter got such a shock that he missed his footing, and but for the promptitude of a fellow - worker, who quickly caught him, he would have fallen into the river far below. The painters work from staging suspended by ropes secured to the girders of the bridge.



Scaffold erected for painting one of the immense chains of the Tower Bridge. Good nerves are necessary for this work.

The Forth Bridge carries the main L.N.E.R. line from Edinburgh - London, and close upon 200 trains cross it daily. Every time a train thunders across, the structure trembles and the top of it sways about four inches. Even when the weather is calm below, a stiff wind is often blowing through the upper steelwork of the bridge, and when a severe storm is in progress the bridge sways to an extent that would alarm anybody on it who was unfamiliar with this characteristic of lofty structures. On those occasions painting becomes impossible, and the men lie down flat along the girders and work their way down to a lower level. During the winter, when the cold and stormy weather makes outside painting unpleasant or impossible, the men paint the inside of the huge tubular girders that form the principal members of the bridge. These long cylinders are 12 ft. in diameter, and the painters work in them by the light of miners' lamps.

The painting of the well-known suspension bridge across the Menai Straits is hardly less thrilling. Our cover this month shows the painters at work on this bridge. As in the case of the Forth Bridge, the work is carried out from staging suspended by ropes. This bridge was designed by the famous engineer Telford and was built in 1819 to 1826. It has a span of 570 ft. between piers, and the suspended superstructure is 473 tons in weight.

The Menai Suspension Bridge comes under the control of the H.M. Office of Works, and when it was examined in 1922 evidence of corrosion was found here and there in links, bars and bolts, indicating that the paint was not adequately protecting the bridge from decay. Even the tiniest holes in a coating of paint allow the corrosive elements of the atmosphere to pass through to the metal, and once through they can work as destructively beneath the paint as though it did not exist. During the next three years severe tests were then carried out with different materials, and in 1925 a silica-graphite paint was adopted, instead of the lead and oxide paints previously used. The repainting of the bridge with the new paint was carried out by a squad of about 50 men, and the work was completed in three months. Two coats of paint were applied, and approximately 300 gallons of paint were used in carrying out the work. The silica-graphite paint successfully withstood the strain of the constant movement of the bridge under all weather conditions, and the same kind of paint was used when the bridge was again repainted last year.

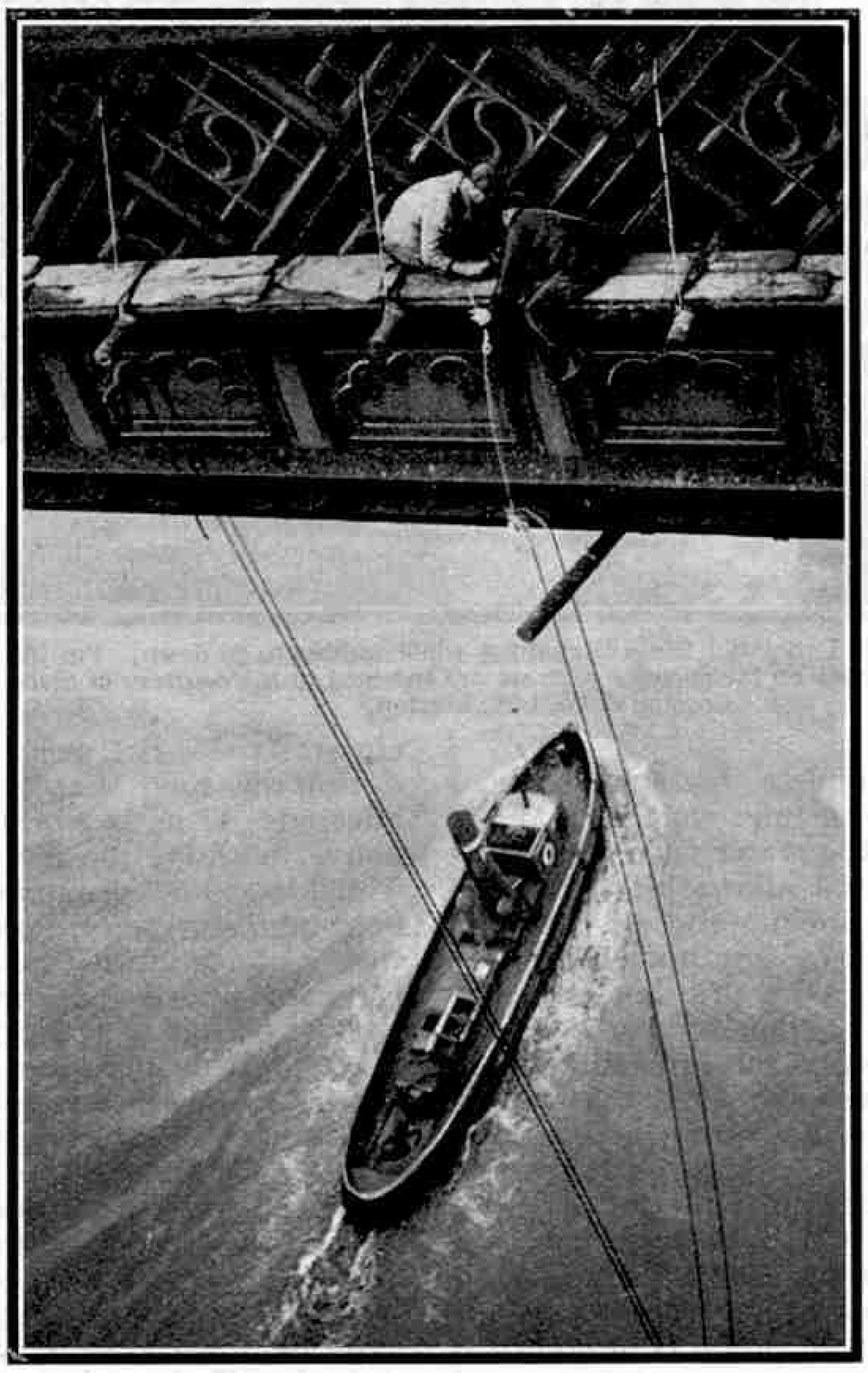
Mention must also be made of the Britannia Tubular Bridge, close by the Suspension Bridge, on which eight men are permanently employed in renovating the structure. The greater part of this bridge is tarred, but painting to the extent of nearly 14,000 sq. yds. is also carried out. Some parts of the bridge are coated annually, but others need attention only every two years, while still others are only repainted every five years. Altogether 450 gallons of paint and 4,100 gallons of tar are used to cover the whole bridge.

The painting of the famous Quebec Bridge over the St. Lawrence River, Canada, is a task of similar magnitude to the painting of the Forth Bridge. The Quebec Bridge has an overall length of 2,830 ft., and a centre span of 1,800 ft. The centre span is 150 ft. above high water, and the cantilevers reach a height of 360 ft. Formerly the bridge was painted by the ordinary hand brush method by a squad of 18 men, but the work is now carried out with spray-gun equipment. This method has been found to be greatly superior to brush painting; for not only is twice as much painting accomplished each season, but also the work is of a better quality than previously. The painting squad consists of ten paint sprayers and their assistants, and scaffold handlers who rig up the stage for the painters and move it about as the work progresses. There is also a blacksmith who makes the special hooks required for the scaffolding, and the various scraping tools used for removing the old paint. In addition to the spray-guns themselves the equipment includes a petrol-driven air compressor, an air-operated winch, and a pressure-type paint container. Five 14-gallon pressure outfits are used, and the painters work in pairs, each man having one assistant.

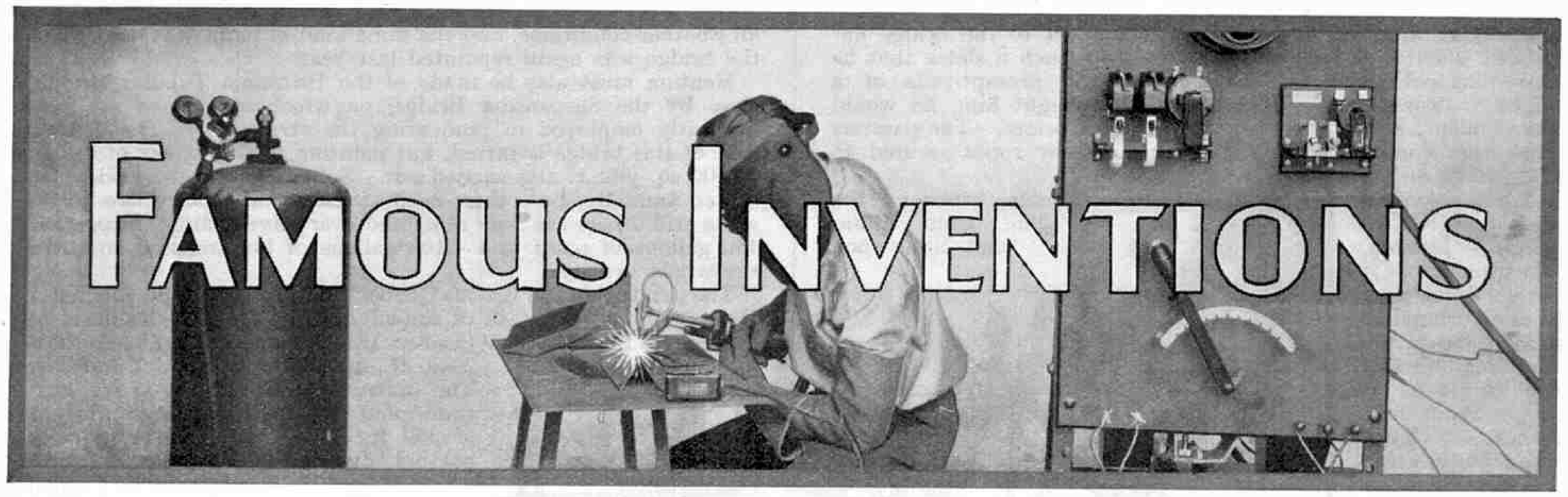
The quantity of paint used is of course enormous, 7,500 gallons being needed to give the bridge one coat, and 70 gallons to give one coat to each of the four main posts. The covering of the bridge with one coat of paint takes three years, but work is carried out only from 15th June to 15th September of each year. While the men are engaged on the bridge the opportunity is taken to inspect it thoroughly, and to grease and oil all movable parts.

The numerous wireless transmission towers that have sprung up in recent years are all protected in a similar manner by a coating of paint. The famous Eiffel Tower at Paris is another structure that provides a big painting problem in order to protect the ironwork.

Ships are painted both for decorative purposes and to preserve them from decay. A ship's hull is painted beneath the waterline with special anti-corrosive compositions to protect it and to prevent marine growths from adhering to it. A great amount of experimental work has been devoted to the production of satisfactory compositions for this purpose, and those that are in use to-day are quite remarkably effective. As is the case with steelwork on land, the protective coating of a ship has to be renewed from time to time, and the vessel is dry-docked for the underwater portion of the hull to be repainted.



Preparing for painting the 230 ft. high-level span of the Tower Bridge, at a height of 110 ft. above the Thames.



XXVII.—THE DIVING SUIT (*Continued*)

IN the previous article we told the story of the invention of the diving suit, and dealt with the equipment of the diver of to-day. This month we shall describe the descent of a diver into deep water, and the conditions under which he works.

Diving operations are usually carried out from a strong broad-beamed boat, large enough to accommodate easily the diver and the men who attend him, together with the pumps and other equipment. On arrival at the place where the diver is to go down, the boat is anchored, and the men fix at one side of it a short ladder leading down into the water, and lower a shot rope until the weight at the end of it touches the bottom. One of the men is specially appointed to wait on the diver. He assists him to get ready to go down, and finally connects to his helmet the air tube leading from the pumps. The handles of one of the pumps are turned a few times, so that the diver can tell by the rush of air into the helmet whether the tube is properly connected or not.

The diver is assisted to the ladder by his attendant, who takes care to keep the lifeline and air tube in hand in case the diver should slip overboard. From this moment up to the time when the diver comes up again the attendant devotes his whole attention to him. When the diver is properly placed on the ladder the men attach the lead weights to his chest and back. One pump is started up, and the attendant screws the front glass to the helmet, so that the diver is now dependent on the pump for his supply of air. While these matters are being attended to the diver makes certain that the outlet valve on his helmet is open, and he notes the position of the shot rope, so that he can help his attendant to lead him to it.

The diver's yarn ! Two "old hands" chatting while waiting to go down. For this illustration and those on the opposite page we are indebted to the courtesy of Siebe, Gorman & Co. Ltd., London.

When the preparation of the diver is complete, his attendant indicates to him by a tap on the top of the helmet that he may descend. The diver then goes down until the water is just over his head, and then lets go of the ladder and allows himself to be drawn to the shot rope by means of the lifeline and air tube. He grasps the rope, but before going down he ascertains whether his dress is leaking anywhere. This he does by pressing for a few seconds on the spindle of the outlet valve, thereby causing a slight increase of air pressure inside his dress, which immediately discloses any leaking places. As soon as he is satisfied that all is correct, and has adjusted his outlet valve, he waves his hand above the water to indicate that he is now ready to go down. The attendant answers by a pull on the lifeline, and the diver begins his downward journey, descending the shot rope hand over hand, but always keeping it between his legs so that he can check his descent at any moment if necessary. In the case of a diver descending to a great depth, a second pump is brought into operation at this stage.

The diver knows that he is going deeper, not only by the feel of the shot rope as it passes through his hands, but also by the fading light, and by the greater pressure of the water, which forces his heavy dress close to his body. This increasing pressure would drive all the air out of the dress and into the helmet but for the fact that sufficient air is pumped down to fill both the helmet and the upper part of the dress. The pressure of the air in the dress is thus kept at least equal to the pressure of the water at the level of his chest. The lungs of a person work comfortably when the pressure inside and outside is the same, but even a slight increase of pressure outside renders breathing laborious. There is, of course, a limit to the rate at which the pumps can supply a diver with air, and if he descends too rapidly for them to increase the air supply correspondingly, the growing pressure of the water about him will subject him to a severe and dangerous squeeze. In practice a diver who is supplied with air by two Siebe-Gorman two-cylinder double-acting pumps can descend to a depth of 180 ft. in $1\frac{1}{2}$ minutes.

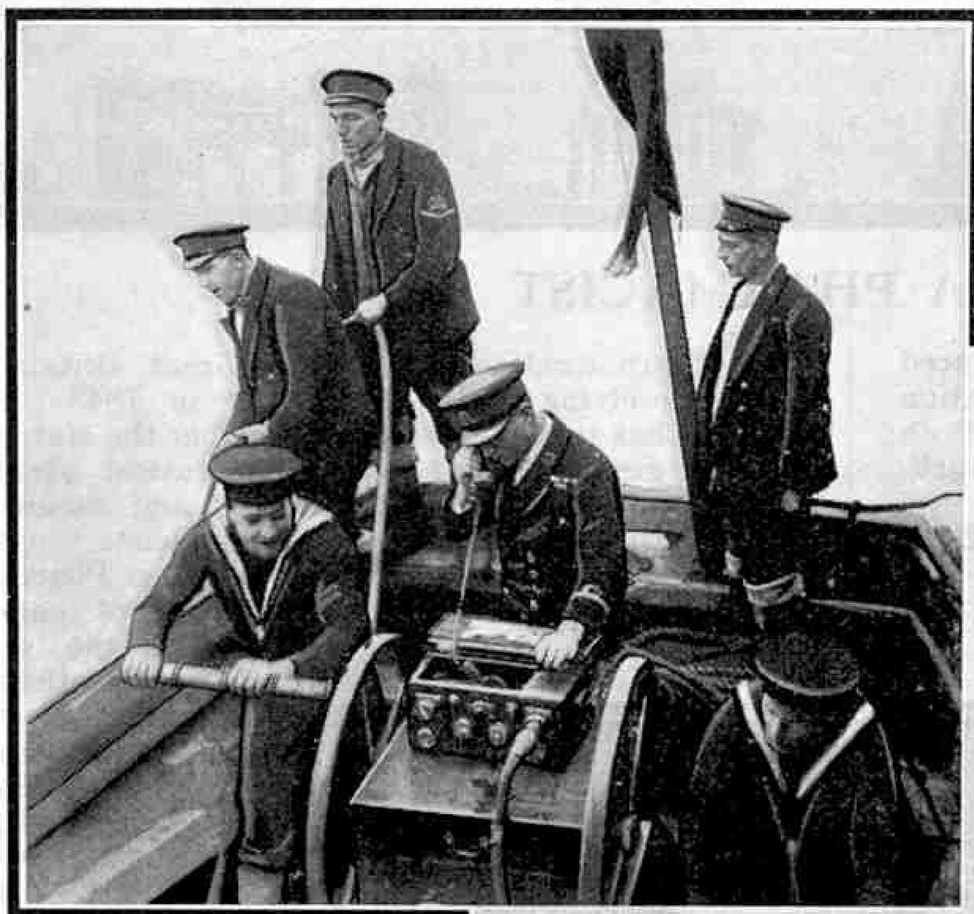
The quickening click of the pumps tells the descending diver that the supply of fresh air is being steadily increased to counteract the greater pressure of the water. This constant click becomes almost a part of himself, and he hears it subconsciously, but the slightest irregularity in it would immediately attract his keenest attention. He signals his arrival at the bottom by a pull on the lifeline, and pauses until this pull is answered by the attendant. He then takes the distance line or rope, one end of which is secured to the shot rope, and coils it in his left hand, paying it out again as he moves away. In this manner he is able to retrace his steps to the shot rope without difficulty when he wishes to return to the surface.

Even in the most favourable circumstances the work of a deep-sea diver is very difficult, and during the time that he is below, his physical senses are curiously affected. If he is working on a sandy bottom, with clear water above, he finds the daylight reduced to a green-grey twilight in which he cannot see more than 10 yards ahead. The bottom may be muddy or rocky, however, and the water far from clear, and then he finds himself in darkness, and is dependent on his electric lamp to reveal his surroundings. While working on a rocky bottom he has to take great care that he does not fall off a ledge or rock into deeper water, or get an arm or a leg caught in a crevice.

The diver's sense of hearing also is affected. If a light explosion were to take place on the surface, he would only become aware of it by the trembling of the sea bed on which he was standing; but if a similar explosion occurred beneath the surface he would hear it clearly up to as much as three miles away. He smells only the odours sent down to him by the pump above; for instance, the smell of oil in the pump cylinders reaches him easily. The movement of the water causes objects to appear weirdly distorted and magnified, and the fish that swim past him seem to be of grotesque shape. He is also strangely helpless, and the pressure

of the water about him is so great that when he wields his axe the blow is many times weaker than it would be above water.

Although the strength of the tide or current on the bottom may be much less than on the surface, the drag of the moving water against the lifeline and air tube is often sufficient to sweep a diver off his feet if he stands erect, and then he has to crouch close to the ground so as to offer as little surface as possible. It may even be necessary for him to crawl on his hands and knees in order to progress safely, but in doing so he runs the risk of too much air getting into his dress. If the air inflates the legs of the dress he capsizes and is blown to the surface, where he floats helplessly. An improved type of diving dress with laced-up legs to prevent the diver from experiences of this kind has been produced by Siebe, Gorman & Co. Ltd., and an illustration of this dress appeared in last month's *"M.M."*



(Above) Telephoning to a diver at work. Two members of the crew are working the air pump, while others in the background are holding the lifeline and air tube respectively. (Right) The returned diver being given a "brush-down" before he reboards the boat.

The diver who is blown up from deep water is in great danger of being affected by compressed air illness, or caisson disease as it is sometimes called. The cause of this illness is interesting. When a liquid is in contact with a gas that does not affect it chemically, it absorbs the gas in quantities varying according to the pressure under which the gas exists at the time. Similarly blood passing through the lungs comes practically in contact with the air admitted during breathing and absorbs it. Air contains three important gases, oxygen, carbonic acid gas, and nitrogen. The oxygen is utilised by the tissues, and the unwanted carbonic acid gas is expelled by breathing out, but the nitrogen remains to accumulate in the blood.

When a diver is working in deep water the nitrogen in the air sent down to him under pressure comes in contact with his blood, which absorbs it in abnormal quantities. This pressure diminishes as he comes up, and if he rises slowly the excess nitrogen gradually passes off through his lungs. If he is blown to the surface, however, the sudden reduction of pressure is too rapid for the nitrogen to be expelled in this manner, and the gas forms bubbles in his blood. These bubbles cause pains in the joints and muscles. If they form about the spine they quickly cause the legs to become paralysed, while if they collect about the heart death occurs in a few minutes. The symptoms of compressed air illness do not occur until after the diver has come to the surface, and to forestall this disease a diver who has come up too rapidly is at once sent down again and then brought up at the normal rate.

If a diver is taken ill before he can be sent down again, and a recompression chamber is available, he is lifted out of the water and quickly placed in it. This chamber resembles a horizontal boiler, and is large enough to accommodate the diver and an assistant. When both are inside, the doors are screwed up until the chamber is airtight, and air is pumped in until the pressure equals that experienced by the diver when he was below. The pressure is then gradually reduced, the time taken being equivalent to that of a normal ascent from the depth at which the diver has been working. If no recompression chamber is available, he is sent down again, if possible accompanied by a second diver to look after him.

A diver also runs the risk of compressed air illness by remaining below too long, and it is a recognised rule that the deeper he is working the shorter should be the time he stays below. The duration of a dive is counted from the time he leaves the surface to the moment he begins to come up. In the British Navy a diver who descends to a depth of 200 ft. must not remain below longer than 12 minutes at a time, and the regulation period for coming up from this depth is 32 minutes, of which five stops of varying duration account for 29 minutes.

When the diver wishes to come up he gives four pulls on the lifeline. He then closes the outlet valve by pressing on the spindle, and thus increases the amount of air in his dress until he is sufficiently buoyant to ascend the shot rope without having to pull himself up. He then gives a pull on the lifeline as a signal to those at the surface that he is leaving the bottom; and ascends easily hand over hand, taking care to keep the shot rope between his legs. His upward journey is broken by a series of compulsory pauses at various depths to allow the nitrogen in his body time to pass off, and his attendant signals by a pull on the air tube when he must stop. During each pause the diver retains his hold on the rope by curling one leg round it, and moves his free limbs about so as to quicken the circulation of his blood, and in this manner help to sweep out of his body the excess of nitrogen. When he reaches the surface his attendant draws him to the ladder, and if he is not going down again, assists him into the boat. If the diver is able to communicate with his attendant by telephone, signalling by pulling on the lifeline is, of course, unnecessary.

The greatest depth at which divers have done practical work in safety is 300 ft., which was attained by divers of the British Navy last year. The periods they spent under water varied from ten to as much as twenty-five minutes.

The tasks that a diver is called upon to carry out are very varied and include the salvage of treasure from sunken vessels, the examination of under-water tunnels, and foundations of bridges, and the cleaning of ships' hulls below the water-line. When a ship has been in the water for a considerable period, marine growths and barnacles accumulate on the bottom in such quantities as to cause an appreciable decrease in speed, and from time to time divers remove this accumulation by means of special tools. This method of cleaning is much cheaper and quicker than dry-docking the ship.

The most romantic work carried out by divers is the salvage of sunken treasure, in which many notable feats have been accomplished. The work is often extremely dangerous, but the pay is good, and the divers frequently receive a percentage of the value of the treasure they recover. One of the most famous salvage feats of recent times was the recovery of nearly £5,000,000 in gold that went down with the White Star liner *"Laurentic,"* which was sunk off the west coast of Ireland early in the War. The loss of this sum was a severe blow to the Treasury, and in 1917 the Admiralty set about recovering it. Operations were carried out during 1917, and from 1919 to 1924, and the naval divers succeeded in recovering all but about £50,000 worth of the gold. Operations were stopped in 1924, but the Admiralty have

(Continued on page 798)

XXIV.—A PHARMACIST

THE beginning of the pharmaceutical profession may be traced to the use of plants for healing purposes, and the preparation of simple extracts from them for use as medicines. Both practices date from very early times and apparently the earliest pharmacists were also doctors, for they both prescribed and provided the medicines that were to heal their patients.

As chemical knowledge increased, more was learned of the effects of drugs extracted from plants, and of chemicals in general, and the drug seller, or apothecary, became increasingly important. His trade did not become a separate one until the year 1617, however, drugs and medicines previously being sold by grocers as well as apothecaries. A charter was granted to the new distinct trade and it was enacted that no grocer should take part in the selling of drugs. In the following year there was introduced the first official pharmacopœia, or book containing directions for the recognition and preparation of medicines. This was compiled by the College of Physicians, and pressure was brought upon apothecaries to dispense or prepare medicines accurately, and in accordance with the directions given in it. The book contained references to such remarkable remedies as crabs' eyes, pearls, oyster shells, earthworms and moss grown on human skulls, all of which were ignorantly supposed to have curative properties in cases of certain diseases! As the pharmacopœia went through successive editions these quaint remedies were dropped, however, and none of them finds a place in the modern British Pharmacopœia, the first edition of which was published in 1864.

As the apothecaries encroached more and more upon the domain of the physicians, they gradually relinquished the dispensing of physicians' prescriptions and the preparation of medicines generally, and this work passed into the hands of the chemists and druggists, who originally were simply suppliers of chemicals and crude drugs to the apothecaries and the general public. The effect of this was to create a separate pharmaceutical profession, the special function of which was to elaborate raw materials into medicinal preparations suitable for administration to the patient. The skill and knowledge of its members increased very largely, and they played a large part in extending knowledge of chemistry, botany and other sciences with which they were concerned. They used this knowledge to raise the standard of purity of the drugs they employed and to improve their methods of dispensing them.

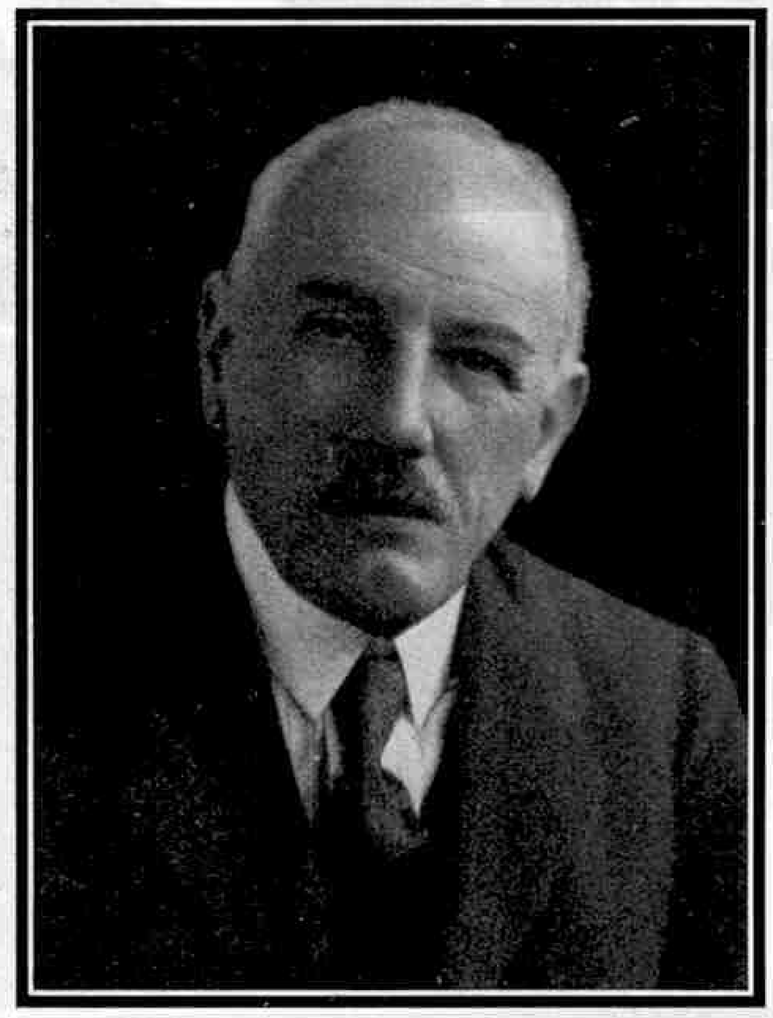
Towards the middle of last century pharmacy had become sufficiently well established to form a representative body, and the Pharmaceutical Society of Great Britain was founded in 1841, receiving a Royal Charter in 1843. The work of this Society has tended to raise still further the status of the profession. It has greatly improved pharmaceutical education, encouraged research, and secured legal privileges for pharmacists. The administration of the various Pharmacy Acts and the examination of candidates and the awarding of the statutory pharmaceutical qualifications are important duties entrusted to it by Parliament.

The modern pharmacist has many responsibilities. Perhaps his most important work is that of dispensing medicines that have been prescribed by medical men. In order that he shall be able to carry out tasks of this kind successfully he must be thoroughly acquainted with the chief characteristics of every material likely to be mentioned in the prescriptions that he dispenses. He must understand the general nature of chemical action, and the conditions in which it occurs, and should have a good knowledge of the principles of physics and of botany, two sciences that are closely concerned with the preparation of the drugs he dispenses. In many instances he is required to show more than a mere knowledge of the materials that he is compounding, for often he must be able to perceive the idea that is at the back of the mind of the prescriber. He must then try to carry out this idea by adopting one or other of the recognised means of administering a particular medicine.

Above all, dispensing must be carried out accurately. The need for this is quite clear in the case of poisons, for the difference between a medicinal dose of a dangerous drug and one that would be fatal is often very small. There is no less need for accuracy in the case of ordinary medicines, however, for too great a proportion of one constituent mentioned in a prescription may completely ruin the effect of the mixture. It should also be noted that the dispenser is the last court of appeal, for when a medicine leaves him, a dose of it is usually taken almost immediately by a patient. If he has any reason to suspect the presence of an error in the prescription, he should at once take action to have it corrected. This means that his knowledge of drugs and chemicals and their effects must be sufficiently deep to enable him to recognise what are reasonable doses in view of the purposes for which they are being prescribed.

It should be clearly understood that there are two grades in the profession of pharmacy. The Pharmaceutical Society grants two qualifications. The first is that of "Chemist and Druggist," and those who obtain it are legally qualified to sell and dispense

An Eminent Pharmacist



Professor H. G. Greenish, D. és Sc., F.I.C., F.L.S., Ph.C., is the Dean of the School of Pharmacy of the Pharmaceutical Society (University of London), in which he is Professor of Pharmacy and Director of the Research Laboratories. He was Joint Editor of the "British Pharmacopœia, 1914," the official standard for drugs.

Professor Greenish was educated in London and on the continent. He has had the honorary degree of D. és Sc. conferred upon him by the University of Paris, and in 1917 was awarded the Hanbury Gold Medal, a distinction conferred for excellence in the prosecution of original research in the chemistry and natural history of drugs.

poisons and are fully privileged to practise pharmacy. They may use the titles, Chemist, Druggist, and Pharmacist, and are eligible for membership of the society with the use of the letters "M.P.S." The second qualification is that of "Pharmaceutical Chemist," and to obtain this requires a deeper and wider knowledge of the sciences on which pharmacy is based and their application to pharmacy. It carries with it the right to make use of the title "Pharmaceutical Chemist," which is usually indicated by means of the letters "Ph. C." together with all the rights and privileges of the Chemist and Druggist.

A reasonably high standard of education naturally is required from those who desire to qualify either as chemists and druggists, or as pharmaceutical chemists. The first step to be taken by those who wish to enter the profession is to pass the recognised preliminary examination, in which they must satisfy the examiners in English, arithmetic, algebra and geometry, and in two optional subjects chosen from a list published by the Pharmaceutical Society, one of which must be a second language. The ordinary School Certificate is a sufficient qualification if certain conditions are fulfilled, but it is strongly recommended that the Matriculation Certificate of a university should be obtained. A boy will have a much better start in his career if he aims at the higher standard required for a Matriculation Certificate. Great care should be taken that all the conditions imposed by the Society are satisfied, and those who contemplate becoming pharmacists therefore should study a copy of the regulations before finally deciding which subjects to offer in the particular examination they propose to take.

The next step after passing an approved preliminary examination is to register with the Pharmaceutical Society. This means forwarding the qualifying certificate to the registrar—it should be noted that the actual certificate obtained must be produced—together with the registration fee of two guineas. No special form of application is needed, and those who have satisfied the conditions are accepted as registered apprentices or students, and are in a position to begin the necessary theoretical and practical training in the principles of their chosen profession.

The laboratory for practical pharmacy in the School of the Pharmaceutical Society, Bloomsbury Square, London, W.C.1. We are indebted to the courtesy of the Pharmaceutical Society for this photograph.

Two courses are now open to the student. His aim is to pass first the preliminary scientific examination and then either the Chemist and Druggist or the Pharmaceutical Chemist qualifying examination. If he wishes he may prepare for the Preliminary Scientific by full-time attendance at a recognised institution where the subjects required are taught. These are chemistry, botany and physics, and a list of suitable institutions may be obtained from the Registrar of the Society. A number of secondary schools are included in this list, and a boy attending one of these may pass the preliminary scientific examination after taking the courses provided for Higher School Certificate or inter B.Sc. candidates and, of course, satisfying the examiners of the Pharmaceutical Society. The Higher School Certificate itself, and the intermediate or final degree examinations of universities, are accepted as equivalent to the Society's examination, provided that the required subjects are passed, and in the case of the Higher School Certificate passed at the "principal" or "main" standard.

Another means of preparing for the preliminary scientific examination is to enter at once on an apprenticeship with a qualified pharmacist in a retail shop or hospital dispensary and to arrange to attend at one of the recognised institutions an approved part-time course of instruction in the subjects of the examination while carrying out the terms of the agreement. The usual term of apprenticeship is three years, and the regulations demand that during apprenticeship a period of 4,000 hours practical training in the compounding and dispensing of medicines should be received. A premium is sometimes required, but as in other professions, this practice is gradually falling into disuse, and any money paid in this respect is usually returned in wages. An apprentice cannot expect to receive much in the way of payment during the years when he is learning the practical duties of his profession, but small wages usually are paid, varying from 5/– to 10/– per week in his first year, to 10/– or even £1 per week in his final year.

Apprenticeships are usually the result of friendly arrangements, but occasionally pharmacists advertise their need of apprentices, and the columns of journals specially devoted to their interests should be studied by those who are unable to find an appointment by other means. A further means of entry is to make enquiries regarding apprenticeships from chemists who appear suitable, and have establishments in the neighbourhood of the would-be chemist's home.

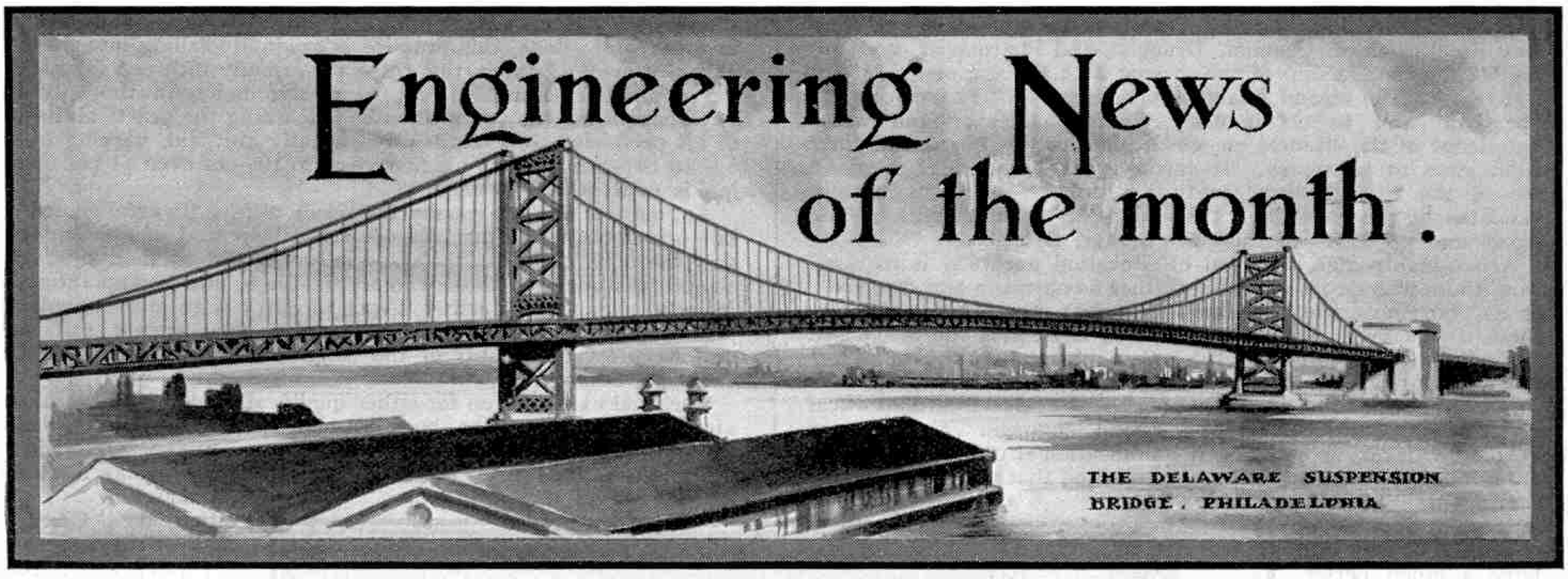
The final examination for either qualification can only be taken after apprenticeship has been served, and those who have not entered upon apprenticeship before passing the preliminary examination must do so now. A candidate cannot take the final examination for either the "Chemist and Druggist" or "Pharmaceutical Chemist" qualification until he has reached the age of 21 years, and in addition to evidence of apprenticeship he must produce a certificate showing that he has attended a year's course in the case of the Chemist and Druggist qualification, or a two year's course in the case of the Pharmaceutical Chemist qualification, in the prescribed subjects at a recognised school or college of pharmacy.

The Pharmaceutical Chemist qualification can also be obtained by holders of the Bachelor of Pharmacy degree of London University by serving an apprenticeship and passing the Society's examination in forensic pharmacy.

It is interesting to note that a number of valuable scholarships are offered for competition among pharmaceutical students. These enable successful students to attend courses of instruction, both elementary and advanced, at the School of Pharmacy of the Pharmaceutical Society and other Schools of Pharmacy, or to engage in research work. Students are strongly advised to study for one of these awards, for the preparation involved cannot fail to help them to pass their qualifying examination. Full details may be obtained from the Registrar of the Pharmaceutical Society, 17, Bloomsbury Sq., London, W.C.1.

The student who has reached the age of 21, and has passed the respective qualifying examination then becomes either a Chemist and Druggist, or a Pharmaceutical Chemist eligible for membership of the Pharmaceutical Society. He is able to practice and may either take up a position as a qualified employee of an established pharmacist, enter the service of a large firm, or set up in business for himself. To start in business on their own accounts is probably the dream of most of those who qualify. For this a knowledge of business principles and methods is necessary, and one of the advantages of the apprenticeship system is that it enables the student to get some idea of this important side of his profession.

It is scarcely possible to acquire sufficient experience of trade in the apprenticeship period, however, for this must be chiefly devoted to securing the necessary qualification. Any chemist who intends to open his own business therefore will be well-advised to spend a further term of four or five years in retail work in order that he may familiarise himself with all sides of it. Then he may open a new business, or purchase an old one. Another method is to enter into partnership with an old-established pharmacist with the intention of ultimately acquiring sole control of the business. In any case capital will be required, (*Continued on page 798*)



An Internal Combustion Turbine

For many years inventors have tried to produce an internal combustion turbine, in which the energy set free by the burning of the fuel employed would be exerted continuously instead of being expended in a succession of thuds and heavy blows, as in the petrol and oil engines now used. A French engineer has designed an engine that may be described as a form of internal combustion turbine. In this the engine is not driven directly by a series of explosions, but by hot air forced by means of a supercharger. The air is raised to a temperature of about 2,300°F. by means of a number of paraffin burners.

The new motor consists of two parts called respectively the stator and the rotor. The rotor fits outside the stator, and each is covered with a coating of fused silica, a material that is capable of withstanding very high temperatures. The heated air acts in a similar manner to the steam of a steam turbine, expanding through specially-shaped grooves cut in the silica linings of the two parts, and thus forcing the rotor to revolve. Additional supplies of air at high temperature and pressure are continually being forced in by a blower, and the movement is continuous.

The burners are placed in the central shaft that carries both the rotor and the stator, and paraffin is supplied to them through a rotary pump. The speed of the engine is controlled by means of a throttle that regulates the supply of fuel to the burners. The rotor makes from 5,000 r.p.m. to 6,000 r.p.m. and models already constructed have completed test trials of various lengths without trouble.

Kaye Don's Motor Boat Record

Kaye Don in "*Miss England II*" set up a record of 89.913 m.p.h. in the first race for the Harmsworth International Motor Boat Trophy, covering one lap at a speed of 93.017 m.p.h. The trophy was retained by America, however, as the British boat was disqualified in the second race.

A small British army tank on the way to manœuvres. It will be noticed that its occupants are wearing gas masks.

Alloy that Absorbs Lubricating Oil

A new self-lubricating bearing material has been invented by the engineers of the Chrysler Motor Corporation. It is an alloy of copper, tin and other metals, and may be made to absorb as much as 40 per cent. of its own volume of oil. The appropriate name of "Oilite" has been given to the material, which may be described as a metal sponge that has been thoroughly soaked in lubricating oil. When it is squeezed in a vice, oil actually drips from it.

The new alloy is much stronger than most self-oiling materials and is largely used for bearings on Chrysler cars and those made by allied companies. It is particularly useful in making spring shackles, and practical trials have shown that it is seldom necessary to apply further lubrication to "Oilite" shackles.

Bennie Railplane Bridge for Blackpool

Mr. George Bennie has suggested that a Railplane bridge be constructed across the River Ribble from Blackpool to Southport, at a cost of about £1,500,000. The suggestion has been approved by the Blackpool Town Council but they are unable to assist financially.

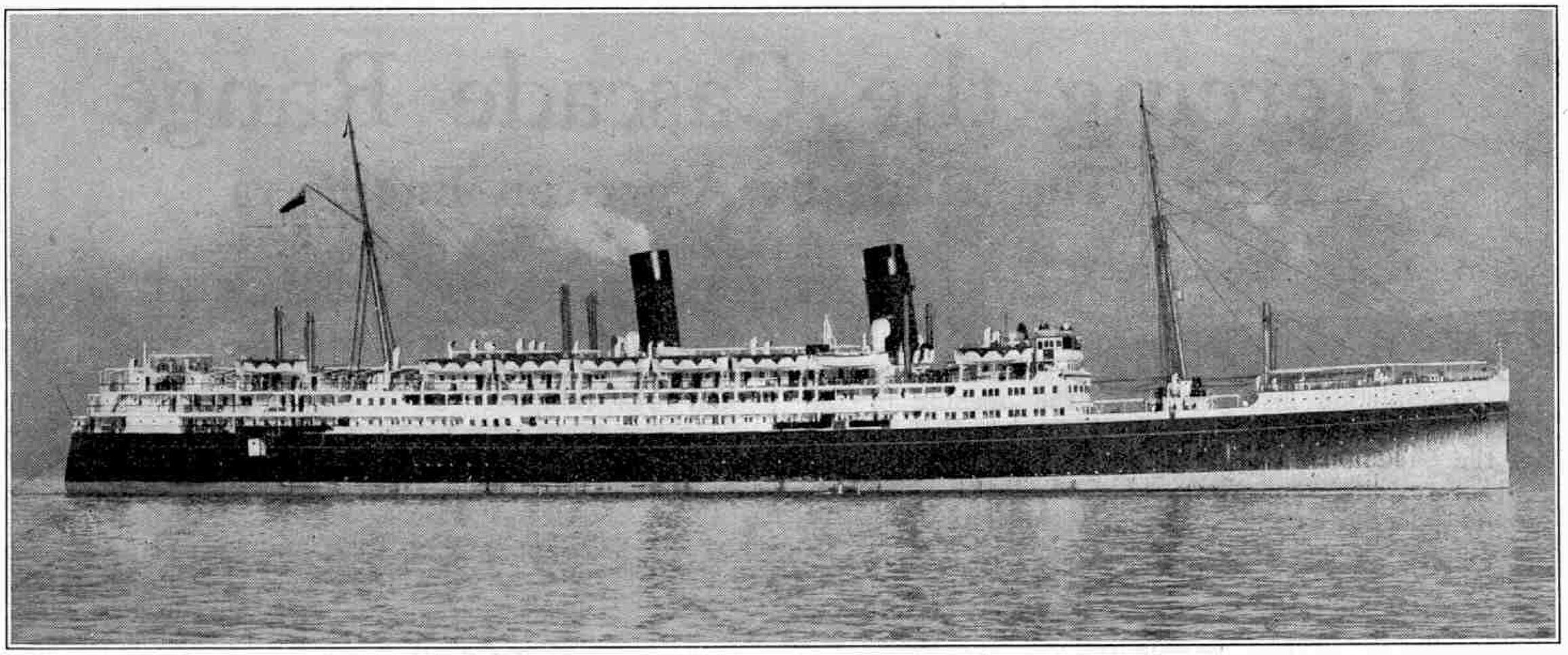
Artificial Lake 41 Miles in Length

A hydro-electric development scheme on which work is now proceeding in South Carolina will eventually provide that State with one of the largest and most dependable sources of electric power in the world. When completed the station will have an average yearly output of about 360,000,000 kw.h., the apparatus in the power house having been designed to possess a capacity of 200,000 kw. The initial installation consists of four Westinghouse water-wheel generators, each of which has a capacity of 40,625 kv.a. Current is generated at 13,200 v. and is stepped up to 114,000 v. for distribution over long distance transmission wires.

The most remarkable feature of the work is the gigantic dam that has been constructed across the Saluda River, the largest earth-filled dam ever constructed. It is nearly a mile and a half in length and contains 11,000,000 cu. yds. of material. At its base the dam measures a quarter of a mile in width and the height from the bed of the river to the crest is 208 ft. The crest is 26 ft. in width and carries a wide concrete highway. The great artificial lake that has been formed behind it is 41 miles in length and 14 miles in width at its widest point, and it has a shore line approximately 525 miles in length. It retains 763 million gallons of water.

60-Ton Floating Crane for South Africa

The Furness Shipbuilding Company Limited, have built a 60-ton floating crane for the South African Railways and Harbours Administration. This is designed to deal with loads up to 60 tons in weight at an 80-ft. radius. The crane itself is carried on a non-propelling type of pontoon that is 160 ft. in length, 55 ft. in breadth and 12 ft. in depth. It is electrically operated and has a 32-ft. diameter roller path. The structure is well reinforced and the shell plating has been designed to withstand the severe corrosion caused by South African waters.



A sectional drawing of the quadruple-screw motor passenger liner "Aorangi," of the Union Steamship Company of New Zealand, which is also seen in the illustration at the head of the page. This fine vessel, which was built and engined by the Fairfield Engineering and Shipbuilding Co. Ltd., Glasgow, has a gross tonnage of 18,500, and is 600 ft. in length, 72 ft. in breadth and 46 ft. 6 in. in depth. She is equipped with Fairfield-Sulzer Diesel engine developing 13,500 h.p., and has a speed of 18 knots.

Eight-Storey Building Moved 52 ft.

An office structure eight storeys in height in Indianopolis in the United States, was recently moved a distance of 52 ft., and was then turned through an angle of 90°. All electric wiring and gas, steam and water piping were maintained by means of flexible connections, and work was carried on as usual during moving operations, even the lifts continuing to run as if the building were stationary.

Before the work was carried out the ground over which the building was to be moved was covered by concrete flooring. Fir timbers were placed on this and rows of steel rails were then laid down 4 in. apart. The building itself was supported by 59 steel columns to which special beams were rivetted for the purpose of transferring the load to the rollers on which the building actually moved. More than 4,000 of these rollers were used and they were placed under steel rail shoes on the sides of the columns.

The building was moved by means of 18 ratchet screw jacks and the positions of the steel rail shoes and the rails beneath them were changed when it was necessary to turn the building round. A stationary steam engine was used in conjunction with the jacks in bringing the building into its final position.

New Turbo Electric Liners

Work is now proceeding so rapidly on the P. & O. turbo-electric liners "*Strathnaver*" and "*Strathaird*" that both vessels are expected to be ready for service before Christmas. They are each 664 ft. in overall length and are equipped with propelling machinery having a total output of 28,000 s.h.p. The designed cruising speed is 22 knots.

World's Largest Train Ferry

The Canadian National Railways train ferry, "*Charlottetown*," claimed to be the largest vessel of her type in the world, is now in regular service on the nine-mile crossing of Northumberland Strait between Cape Tormentine, New Brunswick and Borden, Prince Edward Island. The new ferry has a speed of nearly 16 knots. An unusual feature of the vessel is that she is equipped for service as an ice-breaker. She will therefore be capable of operating the service all the year round.

The new vessel has accommodation for 16 of the latest type railway coaches and 750 persons, including the crew, in addition to 50 motor cars which enter and leave under their own power. The cost of the boat was £456,000.

All-Steel Motor Omnibus Bodies

The Washwood Heath Works of the Metropolitan-Cammell Carriage and Wagon Company have recently been engaged on an order for 20 double-deck all-steel omnibus bodies to be fitted to A.E.C. chassis, and ten single-deck bodies for use on Morris-Commercial chassis. The vehicles are for the Birmingham Corporation and the order was placed after trials of an omnibus with an all-steel body constructed for the Corporation a short time ago.

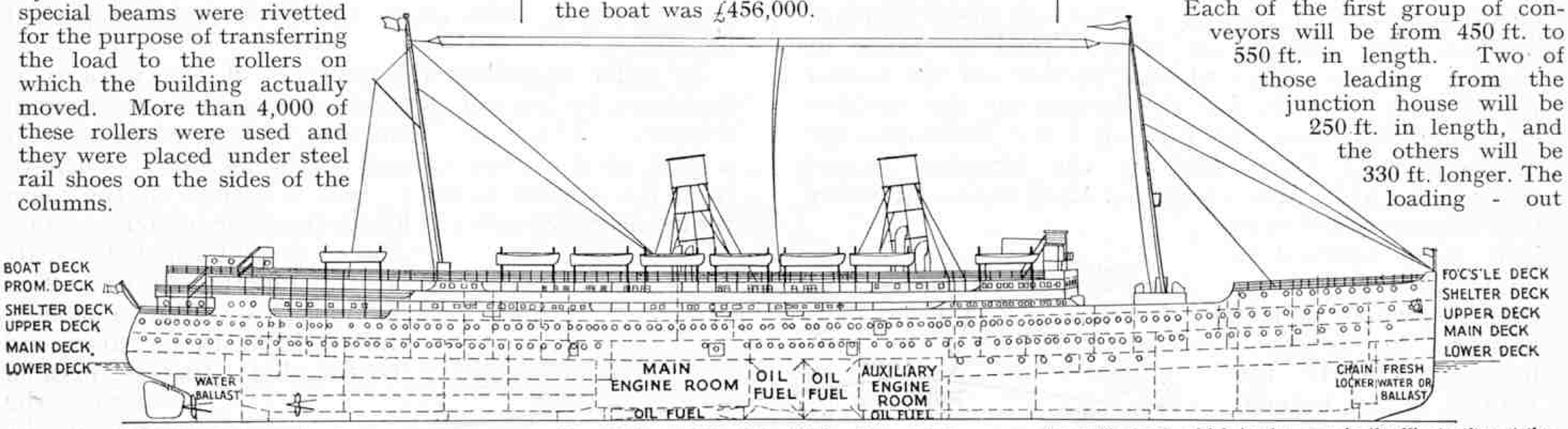
The same firm also are building 25 omnibus bodies to be mounted on Dennis chassis. The vehicles for which these are being made will seat 49 persons and are for the London General Omnibus Co. Ltd.

Coal Shipping Plant for Grimsby

A coal handling plant capable of dealing with 1,600 tons of coal per hour is now being constructed by Henry Simon Limited, of Manchester, for service at the Royal Docks, Grimsby. The installation will be provided with four sets of double hydraulic wagon-tipplers by means of which coal from 20-ton wagons will be fed to conveyors for delivery to vessels in the Docks.

The coal will not be despatched direct to the boats requiring it. Instead it will be taken by four conveyors to a junction house that is to be constructed on a new jetty now being erected. From this it will be delivered by four other conveyors to loading-out towers also situated on the jetty.

Each of the first group of conveyors will be from 450 ft. to 550 ft. in length. Two of those leading from the junction house will be 250 ft. in length, and the others will be 330 ft. longer. The loading - out towers are to be 75 ft. in height, and on each there will be two loading-out conveyors that may be luffed, slewed and telescoped. Their maximum length will be 46 ft. In addition, loading berths will be provided on two of the conveyors leading to the junction house. These will be used by trawlers and small vessels.



Gas Produced From Wood

A gas generator that has been designed in Berlin is claimed to be capable of producing from wood a gas that is high enough in quality to be used for operating motor vehicles. It is stated that the fuel produced by the new generator is considerably more economical than that used in heavy oil engines.

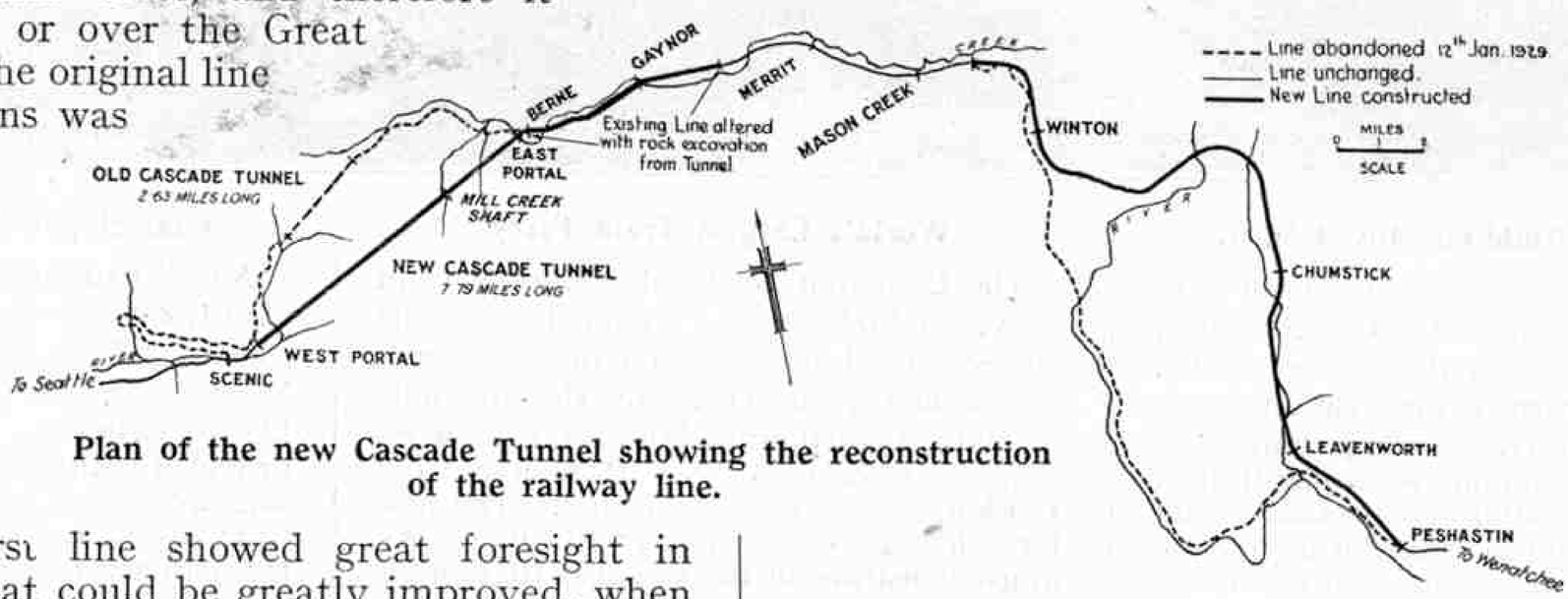
Piercing the Cascade Range

Record Tunnelling by American Engineers

By E. Flaxman

ONE of the greatest and most interesting engineering feats undertaken since the War was brought to completion last year with the opening of the New Cascade Tunnel and the Chumstick Valley Line on the Great Northern Railway of the United States.

This railway runs from Lake Superior to Puget Sound on the Pacific coast, and therefore it must pass through or over the Great Cascade Range. The original line across the mountains was built in 1890-92, and was carried over the summit by a series of switchbacks. In 1900 these switchbacks were replaced by a tunnel 2.63 miles in length. The builders of the first line showed great foresight in selecting a route that could be greatly improved, when occasion demanded, by the provision of a longer tunnel.



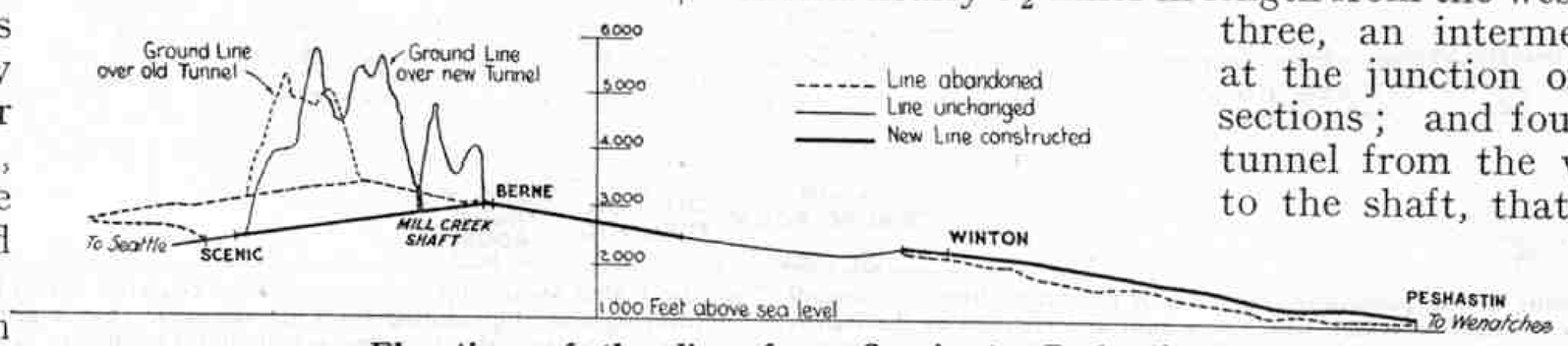
Plan of the new Cascade Tunnel showing the reconstruction of the railway line.

The density of the traffic over this railway increased rapidly, and presently it became desirable to obtain a still easier line at a lower elevation. In 1915-17 surveys were made with a view to the construction of another tunnel, and several schemes were put forward for consideration. One of these schemes involved the construction of a tunnel 17 miles in length! If this plan had been carried out the tunnel would have been by far the longest in the world—excepting of course, the London Tube Railways—the present record being held by the Simplon Tunnel through the Alps, with a length of 12.45 miles. Whether this scheme would ever have been adopted is doubtful, but in any case the whole matter had to be deferred, because in 1917 the United States entered the Great War.

In 1921, when matters had settled down to a more or less normal condition, the question again came up for consideration, and four years later the scheme that has now been completed was adopted as being the most satisfactory in every respect. It involved practically the entire rebuilding of 43 of the 50 miles of line between Peshastin and Scenic, and the construction of a perfectly straight tunnel 7.79 miles in length on a gradient of 1 in 64. From an engineering point of view the work is of exceptional interest. It is the longest railway tunnel in the American Continent and the fifth longest in the world; the other four, which are all in the European Alpine district, being the Simplon, 12.45 miles, the St. Gotthard, 9.28 miles, the Loetschberg, 9.03 miles, and the Mont Cenis, 7.98 miles. In addition, the Cascade Tunnel was driven at an extraordinarily high rate of speed and was completed in record time.

In December 1925 a start was made on the tunnelling work commencing at the west portal on the 14th of that month, and at the east portal 15 days later. The railway company were particularly anxious that the work should be completed in three years, and this made it essential to find other points from which excavation could be effected. The construction scheme provided for both a main tunnel and a pioneer tunnel. At a distance of about $2\frac{1}{2}$ miles from the eastern end the line of the main tunnel crosses a deep rift in the mountains, where there runs a river known as the Mill Creek. A shaft was therefore sunk at this point, giving two more faces, one in each direction, from which the work could be pushed forward.

In order to follow the progress of the work it is necessary to have a general idea of the construction scheme. This really consisted of four parts—one, a section of the main tunnel nearly $2\frac{1}{2}$ miles in length from the eastern portal; two, a section of the main tunnel nearly $5\frac{1}{2}$ miles in length from the western portal; three, an intermediate shaft at the junction of these two sections; and four, a pioneer tunnel from the western end to the shaft, that is, parallel with the $5\frac{1}{2}$-mile section of the main tunnel and, of course, of the same length.

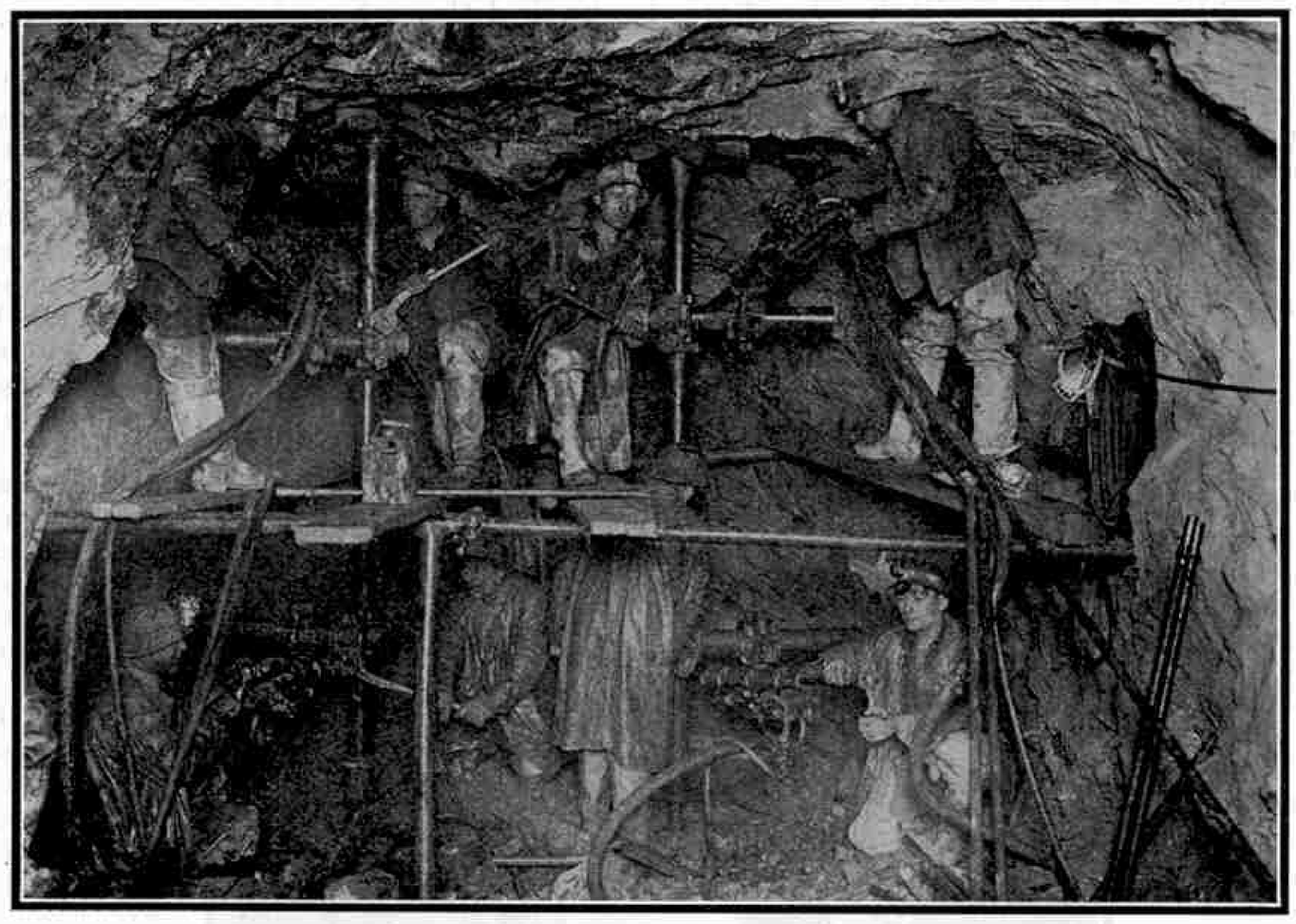


Elevation of the line from Scenic to Peshastin.

The general scheme was to sink the shaft and drive out from it in both directions after commencing in the usual manner from the portals. While these operations were in progress another drift was to be sent out southward from the shaft, and a small pioneer tunnel driven west alongside the line of the main tunnel to connect with that being driven east. From this pioneer tunnel cross-cuts were to be driven at intervals to connect with the line of the main tunnel in order to provide more working faces.

The intermediate shaft was necessary for many reasons, the chief of which was, of course, the need for expediting the work to the utmost possible extent.

Another important use was to deal with the large inflow of water that was expected. As the tunnel is on a gradient falling from east to west, the work of driving eastward from the shaft was on an ascending gradient, and the water flowed to a sump in the bottom of the shaft. Although the depth of the shaft to the floor level of the tunnel is only 622 ft., it was actually sunk to 659 ft. in order to provide the drainage sump and to give room for storage. It measures 8 ft. by 24 ft., and was sunk by drilling and mucking at the same time on different sections. A first portion 8 ft. by 12 ft. was sunk, and after it was blasted, mucking proceeded on this area while drilling was in progress on a section of the same size about 3 ft. above.



Drilling crew at work at the east end of the Mill Creek shaft.

For construction purposes the shaft, as sunk, was divided into four compartments. One of these contained a hoist for men and materials; one was for the ladder, ventilation and air pump line; while the other two were used to remove the excavated material. This was done by skips with a capacity of about 3 cu. yds., which were hoisted at a speed of 885 ft. per min., and could deal with 140 tons per hour.

The pioneer tunnel, 8 ft. by 9 ft., was commenced at the western end about 53 ft. south of the main tunnel, which was considered ample to avoid any danger of crushing in the rock between the two tunnels. When it had proceeded for nearly half-a-mile a cross-cut was driven to the line of the main tunnel. This was necessary in order to allow the first part of the main tunnel to be driven at slower speed, as it was through bad ground and the presence of a river might lead to complications; while the rest of the work could be pushed on. About every 500 yards along the pioneer tunnel cross-cuts were driven to the line of the main tunnel in order to provide extra working faces. In all some 27 of these cross-cuts were made, enabling nearly 1,800 men to be employed on the work at one time! Obviously this comparatively small tunnel could be constructed at a much faster rate than the main tunnel.

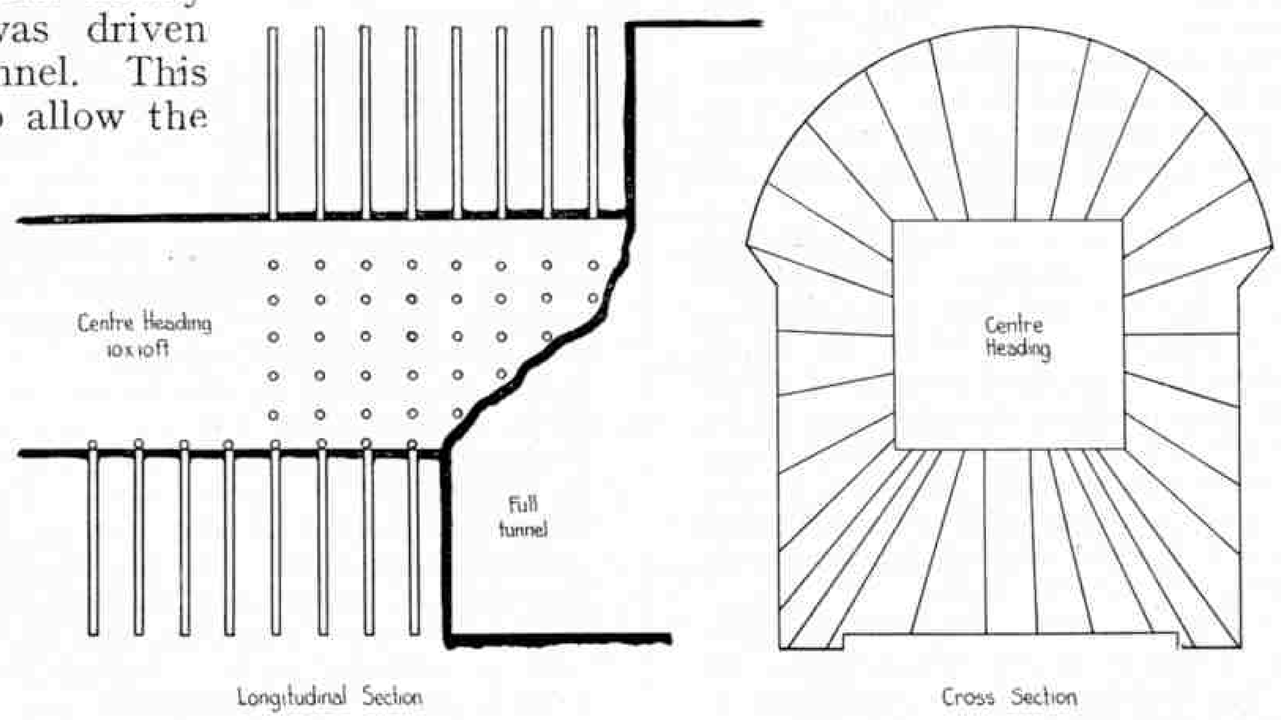


Diagram showing method of enlarging the main tunnel from the centre heading.

A typical "cycle" on the pioneer tunnel for one round of drill holes is interesting as showing the speed at which the work was carried on. At 7.10 a.m. a charge of 195 lb. of gelatin was fired, and for the next 27 minutes air was pumped in at a rate of 6,000 cu. ft. per minute in order to clear the atmosphere and make it possible for the men to return to work. During the following two hours the electric light and compressed air lines were replaced, and the blasted rock was cleared and loaded away.

The next 38 minutes were occupied in removing the mucking machine and bringing up the drill carriage, holding four drills, each manned by a driller and his helper. The drill holes averaged $8\frac{1}{2}$ ft. in depth, and 28 of these occupied the next hour and 17 minutes. While the drilling was in operation an insulated powder car was brought up with the necessary charges. Some of the drill crew then took the carriage back, while the rest charged the holes, this operation taking 13 minutes. When the blasting apparatus was ready, all the men retired to safety and the charge was fired at 11.50 a.m., the total time for the advance of 8 ft. having been 4 hours 40 minutes.

The pioneer tunnel was used for carrying the compressed air line that operated the drills and shovels, and the electricity supply for other machinery and for lighting. It was used also for carrying the workmen and supplies; for pumping air for ventilation; for carrying off water from the main tunnel, and as a haulage way for the disposal of the excavated material from the inside faces.

In spite of the fact that most of the work was through solid rock there were, as might be expected in a work of such magnitude, many difficulties to be overcome. Stretches of bad rock were encountered containing water under pressure, and at one time the inflow reached a rate as high as 10,000 gallons per minute. This, of course, necessitated a great amount of pumping in order to prevent the workings from being flooded. Such lengths of treacherous ground made it essential to work slowly and carefully through these parts, and to have ample supplies of timbering available and promptly placed in position.

The pioneer tunnel is 28,292 ft. in length and contained 94,900 cu. yds. of excavation. The pioneer

headings met on 1st May, 1928, the final blast being fired by President Coolidge, at Washington, by pressing a button on his desk and thereby closing an electric circuit to the tunnel.

The centre heading method of driving was adopted as the barrier was solid rock, mainly granite, practically throughout. This heading, 10 ft. by 10 ft., was made by alternate drilling and excavating in the western portion. In the eastern portion, where there was no pioneer tunnel, the two operations proceeded simultaneously, one half being drilled while the other half, previously blasted, was being excavated. On the western portion, as soon as excavation had been completed, a drill carriage running on a track of 2 ft. gauge was brought up to the face. Twenty-seven holes, varying from 8 ft. 6 in. to 9 ft. 6 in. in length, were driven for each round. As soon as drilling was completed the carriage was run back, while the holes were charged with 250 lb. of dynamite, and the blast was fired.

At some places, where the rock was bad and contained water under pressure, it was necessary to drive a top heading in order to provide a protective roof covering.

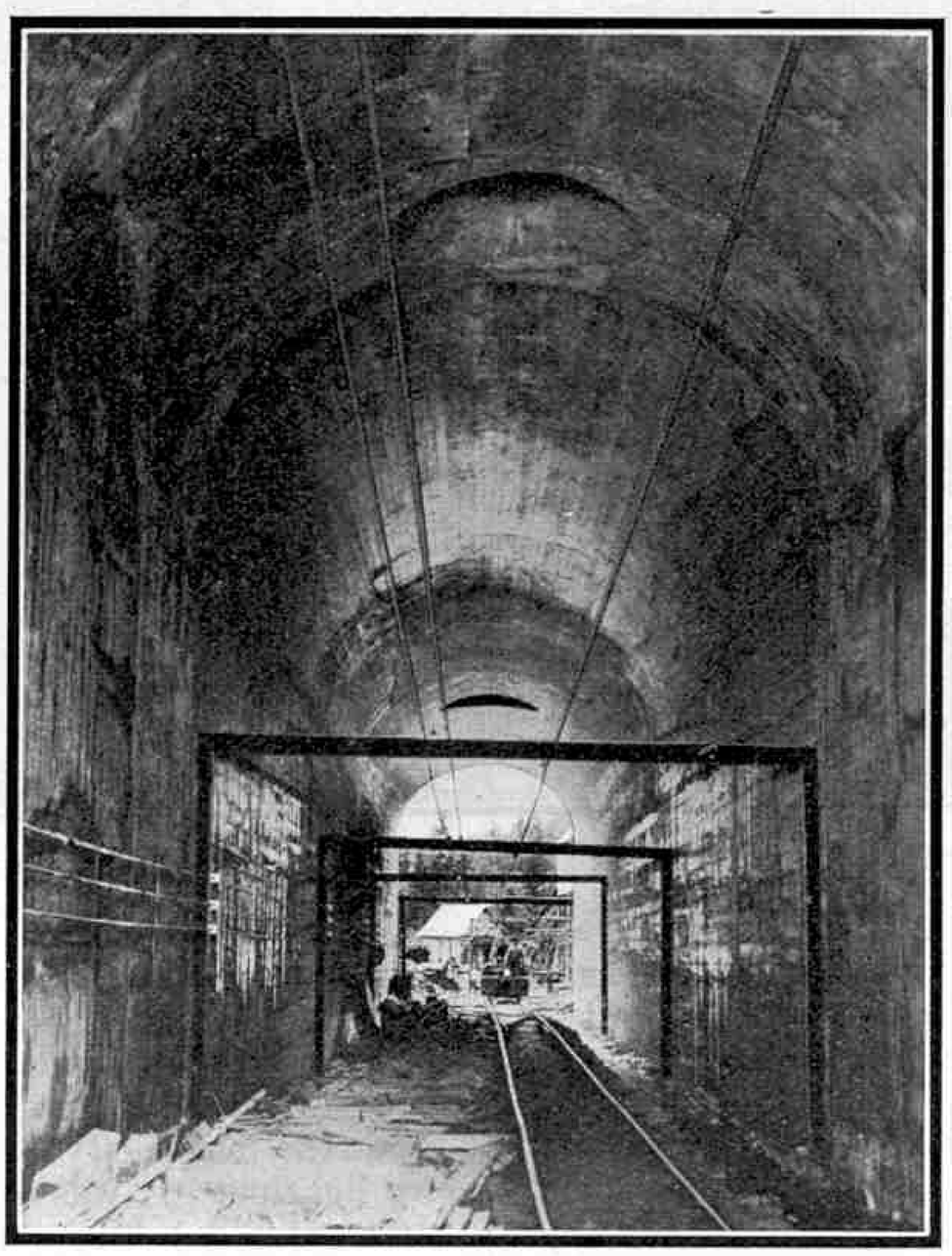
In both the centre heading and the pioneer tunnel haulage was performed by six-ton electric locomotives, operating trucks with a capacity of 2 cu. yds. on a track of 2 ft. gauge, the cars being loaded by electric machines. There were two tracks, one for loaded cars and one for empties; and in order to avoid the delay of switching empty trucks over ready to be loaded, a derrick crane was used. As soon as a loaded car was hauled away, the derrick picked up an empty one and lifted it over to the loading track, while the locomotive of the empty car train pushed another truck up into position.

The centre headings for the main tunnel between Mill Creek shaft and the east portal met on 4th March, 1927; while those between Mill Creek shaft and the western portal met on 20th October, 1928.

The enlargement of the tunnel to full size, approximately 18 ft. by 25 ft., was carried out by the radial or ring method. Each ring consisted of 29 holes spaced about 4 ft. apart, and radiating outward from the centre heading. In order to facilitate the drill setting, red lines were painted along the centre of the floor and on each side at about 3 ft. up. Power shovels mounted on caterpillars were used to enable the speed of excavation in the enlargement to be increased. These shovels loaded the material into trucks with a capacity of about 6 cu. yds., running on a track of 3 ft. gauge and hauled by electric locomotives.

The enlargement was finally completed on 8th December, 1928, and after this had been carried out there remained the lining. Although, as has already been stated, the tunnel passes through solid rock practically throughout, the 18 ft. by 25 ft. enlargement is lined with concrete to a finished section of 16 ft. by 20 ft. 10 in., the average thickness of the concrete being 33 in. In the course of this work nearly 263,000 cu. yds. of concrete were placed in position. A number of portable concrete mixers and placers were used in this operation, and they were arranged so as to stand astride the narrow gauge construction tracks in order to avoid interference with the other work.

Ventilation for the headings and for the completed portions of the tunnel was supplied by powerful motor-driven fans. At the west end a fan situated on the outside delivered 20,000 cu. ft. of air per minute into the pioneer bore, which served as a conduit, the cross-cuts to the main tunnel being closed. At a distance of some 2,000 ft. from the face of the pioneer a cross-cut was left open and the pioneer bore closed, so that the air current was thus diverted into the centre heading and the main tunnel. Another fan capable of dealing with 9,000 cu. ft. per minute was placed in a chamber at a point where the pioneer bore was closed, and this delivered air through a 20-in. sheet-iron pipe to the face of the pioneer heading, and to two headings of the main tunnel. The pipes were fitted with reversing gates, so that the fans could be utilised to deliver fresh air, or to draw out foul air, as desired. In the finished tunnel no scheme of artificial ventilation is needed. Its continuous inclination produces a strong upward current of air, in addition to which the traffic is handled entirely by electric locomotives.



Looking out through the mouth of the tunnel. The concrete lining is shown, and the narrow gauge track that was used during construction.

The most important factor in the extraordinarily high speed at which the tunnelling was carried out was the preparation of an elaborate schedule, which was rigidly adhered to as far as possible. This was effected by careful organisation of working. The construction was carried on day and night, week-day and Sunday, without interruption throughout the whole period; shifts being changed at the face, and one drilling crew replacing another without any stoppage of work. Even Christmas was worked through, and there was a considerable amount of healthy rivalry between the various gangs as to which could establish fresh progress records. A bonus system of payment was introduced, and this no doubt had its effect in speeding-up the work. Throughout the entire construction period not a single shift was lost.

The work of the railway engineers was remarkably good. The centre line for location was carried over the mountains directly above the main tunnel and reached a height of 3,500 ft. above the west portal over an extremely difficult and precipitous district. For the actual setting inside the tunnel there was little time available owing to the terrific pace at which the work was carried on. However, the calculations and the instrument work were so accurate that when the headings finally met, some 3,000 ft. underground and four miles inside, there was a difference only of 9 in. in elevation and 7 in. in alignment!

The economy of material is also remarkable, as the whole of the rock excavated was used on improving the lines outside the tunnel, and ultimately not a single cubic yard was wasted.

The new tunnel gives greatly improved operating conditions, and in addition it provides protection against the grave dangers of snow-slides. Nearly six miles of snow-sheds, which are very costly to maintain and to renew, have been dispensed with; and the necessity for snow removal over a long stretch of open track has been eliminated.

The cost of the construction of this interesting tunnel was over £2,800,000. The total cost of the work, including some 20 miles of approach reconstruction and the electrification of 73 miles, was approximately £5,000,000.

The driving of this tunnel through a mountain range was accomplished in 37 months, that is to say at an average rate of one mile in $4\frac{2}{3}$ months. This constitutes a record for tunnelling. It is interesting to compare the figures with those of the Connaught tunnel (1915) on the Canadian Pacific Railway, which are the previous best. The Cascade pioneer tunnel measured 8 ft. by 9 ft. and that of the Connaught Tunnel $6\frac{1}{2}$ ft. by 8 ft. The record figures of progress for the former were one day, 52 ft.; two days, 90 ft.; three days, 140 ft.; and one month, 1,157 ft. For the Connaught Tunnel the corresponding figures were 37 ft., 68 ft., 98 ft., and 932 ft. respectively. The enlargement of the Cascade Tunnel proceeded at the rate of 1,220 ft. in one month; the corresponding figure for the Connaught Tunnel was 1,030 ft. The latter tunnel is bored through Mount Macdonald in the Selkirk Range, British Columbia, and it carries the Canadian Pacific trans-continental route. Formerly the line proceeded by way of Rogers Pass, and the tunnel has not only eased the gradient considerably and shortened the distance by about $4\frac{1}{2}$ miles, but also has brought about a great saving by eliminating the heavy cost of keeping the Pass open during the snow season.

Prior to the completion of the Cascade Tunnel, the Moffat Tunnel, 6.09 miles in length, was the longest tunnel on the American continent. This tunnel pierces the James Peak in the Rockies and opens up the vast forest, mine, and agricultural resources of western Colorado. It shortens the distance for transportation between Denver and Salt Lake City by over 170 miles; and it resembles the Connaught Tunnel in saving an enormous sum that previously had to be spent every winter in keeping the line open and free from snowdrifts.

The Cold Storage of Fruit

An Interesting Swiss Installation

BEFORE the introduction of cold storage there was no means of preserving foodstuffs for any length of time. Whatever could not be consumed immediately was therefore wasted. The earliest method of cold storage consisted simply of freezing the product and keeping it frozen; but later it was discovered that extreme cold was not only unnecessary, but actually harmful. Scientific investigation has shown that different foodstuffs require different degrees of coldness to maintain them in good condition, and without loss in quality, and specialised forms of refrigerating plant have been devised for dealing efficiently with all kinds of meat and fruit, and in fact with anything that is worth preserving.

One of four insulated rooms for storing fruit at the cold storage plant of the Association of East Swiss Agricultural Societies, Winterthur. The refrigerating plant was supplied by Sulzer Brothers, to whom we are indebted for our illustrations.

An improved plant for the treatment of fruit has been erected at Winterthur, Switzerland, for the Association of East Swiss Agricultural Societies. In Switzerland fruit comes fourth as regards value in the list of agricultural products, and its importance is steadily increasing. Prior to the erection of this plant, however, there was no means of utilising the fruit to its full value. The installation not only provides a complete and up-to-date refrigerating plant, but also serves as an experimental plant that will help to determine exactly what kinds of fruit are the most suitable for preserving in cold storage. The building includes also an improved co-operative mill, equipped with the latest type of machinery. On the ground floor there is a modern fruit press and fruit-drying plant, while in a double cellar that extends beneath the whole building there are large cold rooms for storing fresh fruit, and tanks for unfermented cider. The four insulated fruit cellars have a floor area of about 2,000 sq. ft. and are kept at a temperature of from 0 to +4 deg. C. according to the kind of fruit stored in them. The cold storage accommodation at present provided is for a maximum of ten 10-ton wagons of fruit.

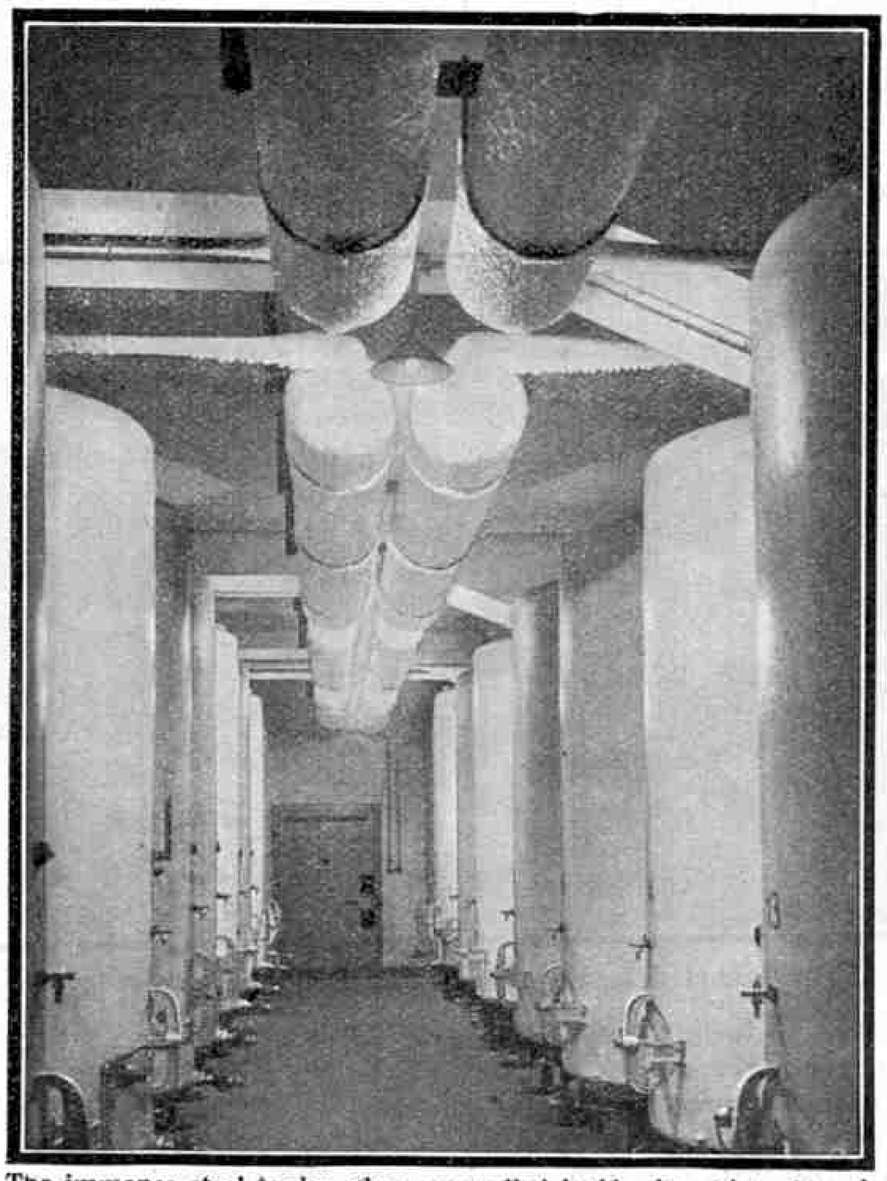
The fresh fruit is carefully sorted on arrival, only first-class fruit being sent to the cold rooms for storage; all the rest, without exception, is put aside and utilised in some other manner. Fruit that is found to be absolutely faultless is laid, piece by piece, between corrugated paper in special crates. It is of importance for good preservation that the temperature of the rooms should be kept as constant as possible, and that the humidity of the air should not vary beyond certain figures, depending on the kind of fruit stored. Both these factors have a considerable influence on the vital functions of the sound fruit, and consequently also on the time during which it can be preserved in the cold stores.

Beside the fruit cellar there is an ante-room, in which the fruit is gradually warmed up after it has been brought out of the cold rooms. If this were not done the fruit would become covered with moisture on coming in contact with the outer air, and this would lead to its rapidly going bad. The ante-room is provided with a special ventilating installation and electric heating.

The refrigerating plant is supplied by Sulzer Brothers, Winterthur. It is designed for handling 3½ tons of fresh fruit daily, and also for cooling 2,200 gallons of cider daily, this being prepared in about five hours.

The fruit to be made into cider passes on arrival direct from the railway wagon into boxes, and from there, after it has been washed, it travels automatically into the elevator up to the mill and into the press. At the outlet from the press the juice flows over a cider cooler into a collecting tank, where it is partly clarified. After being filtered it then flows at a low temperature into steel tanks, glass enamelled inside, where it can develop, but is prevented from fermenting by being kept cool.

The storage cellars are maintained at a very low temperature by means of brine, which is cooled in special coolers by an ammonia refrigerating plant. The principal apparatus of this plant consists of a two-stage ammonia compressor with a rated capacity of 160,000 B.Th.U. per hour, belt-driven by a 27 h.p. electric motor; a double-tube condenser and a brine cooler. The plant is situated on the ground floor in a large and well-lighted machine room. All the apparatus is designed in such a manner as to provide for the possibility of doubling it later on. The centrifugal pump, which also is installed in the machine room, forces the cold brine through a central control station situated in the ante-room, and then to the various places, where cold is required.



The immense steel tanks, glass enamelled inside, in which cider is stored at a low temperature.

In the tank cellar the cooling elements consist of pipes fitted along the walls, and brine accumulating pipes suitably distributed on the ceiling. The fruit cellar is cooled partly by cold air circulated by means of a fan, and partly as in the tank cellar by means of brine accumulators fitted on the ceiling. The adoption of two systems of cooling has the advantage of making it possible to increase the humidity of the air in the respective cold rooms. This is a very valuable feature, for when the fruit becomes too dry it begins to shrivel up and to lose flavour.

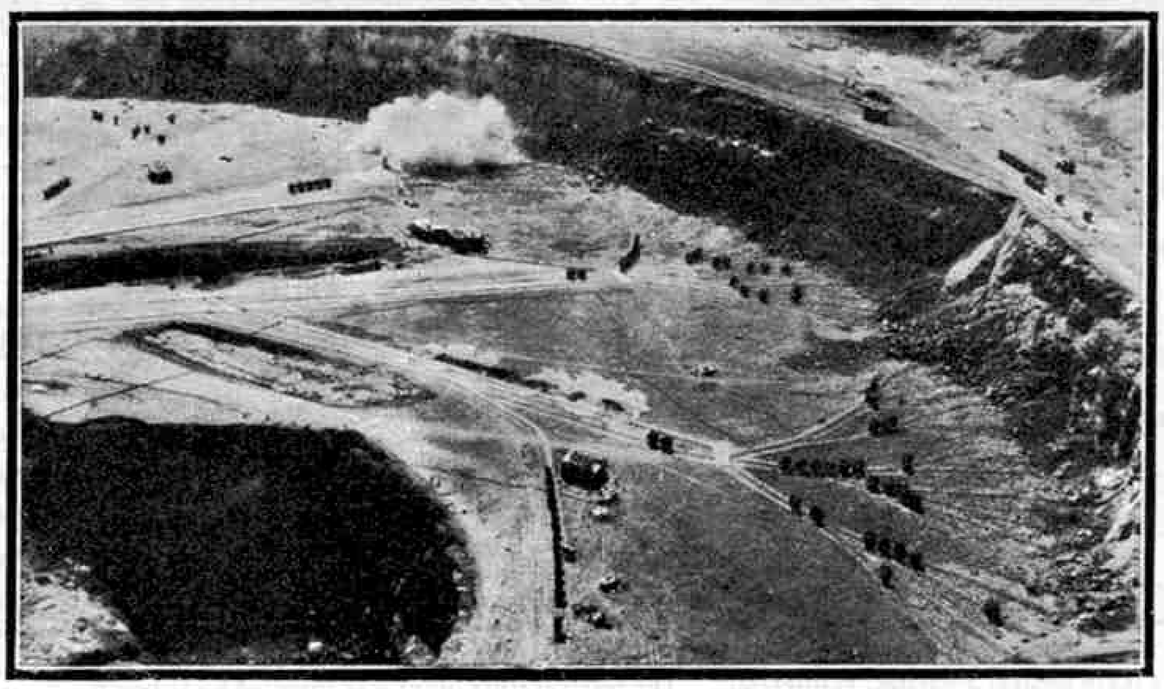
Fresh air is introduced to the fruit stores through an air cooler. In passing over the cooler the air is dried, cleaned and cooled, and the humidity of the air in the rooms is thus prevented from becoming too great. Carbon dioxide is given off by the fruit, and it falls to a low level in the rooms. It is necessary (*Continued on page 798*)

The Mineral Wealth of South Africa

The World's Largest Diamond and Gold Mines

SOUTH AFRICA is one of the richest mineral areas in the world and it contains the world's greatest diamond and gold fields. Little more than sixty years ago very few of these mineral deposits were known, and the history of the country since then has been shaped largely by the successive discoveries of valuable deposits, and by the struggles, peaceful and otherwise, that have resulted from the efforts to secure control of them.

The finding of the first diamond in Griqualand West in 1870 may be said to have marked the beginning of a new South Africa. The news of the discovery spread like wildfire, and men of every class and trade came from all quarters to seek their fortunes in the diamond field. When the first Kimberley diamond was discovered, during the following year, the rush of prospectors became greater than ever. Transport from the coast to the mining area, nearly 700 miles inland, was organised, and the railways were rapidly extended towards Kimberley, which soon became the hub of South Africa. Other diamond mining districts were subsequently opened up, and the industry grew to immense proportions.



Diamond mining at Koffiefontein, one of the towns in the Orange Free State that owe their existence entirely to the mining industry. For the illustrations to this article we are indebted to the courtesy of the "South African Railways and Harbours Magazine."

The surface of the diamond-bearing country is red or yellow sand, below which is a deposit of lime that covers the flint-like "blue" rock or diamond-bearing earth. The earliest diggers, working with the crudest appliances, had to confine their activities to the sand, and when they had penetrated to the "blue ground" they gave up their efforts in the belief that the diamond deposits were exhausted. As a result something of a panic prevailed among the diggers, and holdings that had been valued at a high figure were sold for very small sums. For a time it looked as though a promising industry was on the point of being extinguished, but the situation was saved by the introduction of more powerful mining equipment. When the rock was blasted out, broken up small by the action of water, and passed through combing machinery, it was found to be greatly richer in diamonds than the sand that had previously been worked.

The inclined plane leading to the workings of a diamond mine.

The Kimberley diamond mine is the pipe of an ancient volcano that has been excavated to a great depth by prolonged digging. The following interesting reference to this mine is made in the "*South African Railways and Harbours Magazine*" for December 1928: "The sightseer who to-day stands on the brink of the great cavity which is the site of the famous Kimberley diamond mine, is viewing not only one of the most remarkable sights in South Africa, but is in the presence of a phenomenon which has played a great part in this country's history and development. His physical eye presents to him a huge funnel-shaped hole, half a mile in diameter, which at a depth of 300 feet plunges into a sheer vertical throat nearly a thousand feet deep. At its bottom he will see a placid sheet of water, which at that great depth looks like a mere pool, but is in reality many acres in extent. . . . Far down in the throat of the pipe he may see almost invisible pigeons and swallows wheeling about in the open space where once miners, black and white, burrowed in the solid rock in long-since-gone tunnels, shafts, and underground chambers, and where they won the blue ground from which the sparkling gems were recovered."

The most important mineral that is won from the rich territory of South Africa is gold. Mining for gold has been carried on in the country from very remote times, and ancient workings are found in many places between the Zambesi and the present-day gold field of the Witwatersrand. The modern era of gold mining began in the early sixties of the last century, and the first flourishing gold fields were opened at Lydenburg in 1873. Other fields were opened up later and finally there came the discovery of the wonderful deposits of the Witwatersrand, now the greatest gold field in the world. The name means "White Waters Ridge," and was given to the locality by the Boers on account of the streams of clear water that issue from the northern side of the range and ultimately find their way into the Indian Ocean at Delagoa Bay.

In 1884 deposits of gold were found on the property of a Dutch farmer on the lonely high veldt. These did not turn out to be as remunerative as was hoped and expected, but the results were sufficiently promising to encourage the continuance of prospecting in the neighbourhood. About a year later a mason employed by a Dutch farmer came across a rock formation that struck him as being peculiar, and aroused his curiosity. He crushed some of this rock and found it to contain gold, and this accidental discovery led to the knowledge of the enormous gold wealth of the Witwatersrand.

The news of the discovery spread rapidly, and soon there was a repetition of the rush to the Kimberley diamond field. In the case of the Witwatersrand gold rush, the Transvaal Government promptly took the opportunity presented of raising money, and arranged a sale of land from which some £13,000 was realised. A township was laid out, and further sales of land brought in more revenue amounting to about £40,000; while the value of small plots of parched veldt rose from a few shillings to hundreds of pounds. In this manner was brought about the beginning of the Witwatersrand gold industry and the birth of Johannesburg.

The Witwatersrand gold field is situated on a plateau nearly 6,000 ft. above sea level, and the gold bearing beds are known locally as "reefs." They consist of a conglomerate of quartz pebbles, bound together by stony cement, to which the Dutch gave the name "banket," on account of its close resemblance to an almond sweetmeat of that name. In most cases the gold contained in the conglomerate is not visible to the naked eye. Experienced observers often mistake for gold the sparkling crystals of pyrites and quartz grains.

To-day many of the Witwatersrand gold mines extend to a

depth varying from 2,000 ft. to 7,000 ft. The main shaft of the mines is sometimes sunk vertically, and sometimes on an inclined plane as in the case of the Koffiefontein diamond mine shown in the accompanying illustrations. Small tunnels or levels branch off at intervals of usually 250 ft. and secondary means of communication between these levels is provided by narrow sloping tunnels with crudely hewn steps called by the miners "winzes" or "raises." The descent of a mine having a vertical main shaft is made in "skips" or cages. Underground there is an immense labyrinth of tunnels branching away from the main shaft. Small excavations called "cross-cuts" are made at right angles to facilitate close examination of the formation containing the minute grains of gold. In the parts of the Rand where the levels are several thousand feet underground, ventilation is maintained by compressed air appliances operating in the mines themselves.

A native at work with a compressed air drill in one of the narrow levels of a South African gold mine. The photograph gives a good idea of the cramped quarters in which the miners work.

In the depths of the mines drilling of the rock preparatory to the insertion of dynamite charges goes on day and night. Formerly this was carried out entirely by native boys working with hand hammers; but to-day powerful drills, operated by compressed air, are in general use. A "jack-hamer," as it is called, of the type shown in the accompanying illustration, replaces 17 native hammer boys, and does more work per shift. When the boring has penetrated to the required depth, an explosive charge capable of unbedding from 14 to 16 tons of rock is inserted, plugged and fired. The lumps of disintegrated rock, small and large, are loaded into tip wagons that are pushed along the bogie track threading the trench or "level" until the foot of the main shaft is reached. Miles of wagon tracks are laid down in these many-tunnelled mines. From the bottom of the shaft the rock is conveyed rapidly to the surface by means of elevators, some of which can lift at the rate of two tons per minute.

At the surface the "skips" are tipped automatically, their contents being ejected on to a slowly moving conveyor belt that passes through a sorting house. Specially trained men or boys, stationed at intervals along each side of the belt course, pick out of the assortment of broken rock any pieces of useless material, the presence of which would interfere with the subsequent process.

The ore is next tipped into huge storage bins, from which the smaller pieces fall through wide-meshed screens into lower bins. The lumps of ore that will not pass the screens rumble away down the sloping floor of the upper bins and through a trap door that precipitates them into the stone-crushing machines, which work them down to the size of small macadam. Finally, these pieces of ore join the earlier arrivals in the lower bins.

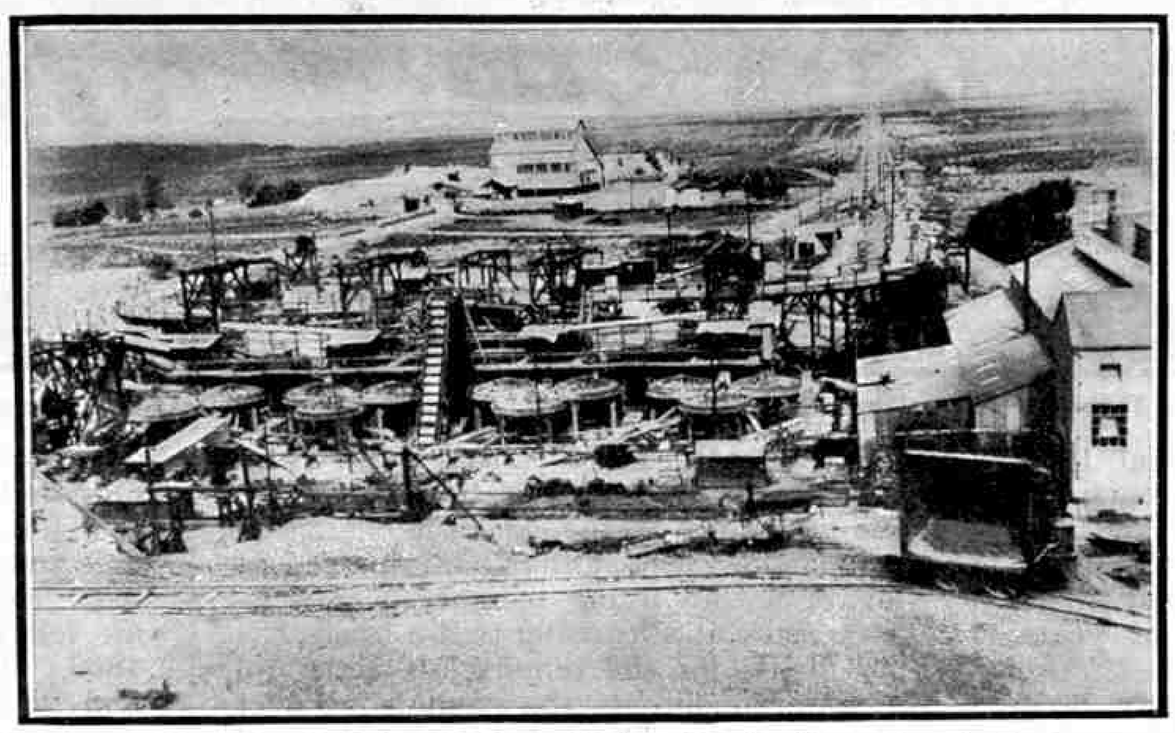
From the second bins the broken ore is taken to the batter house, where powerful machines stamp or crush it to powder as it passes beneath them in a continuous stream. Working day and night, these huge machines, each stamp of which weighs about three-quarters of a ton, create an unceasing deafening roar. The stamping weights are lifted by cams and suddenly released, so that they come down with terrific force on the lumps of ore, which ultimately are crushed sufficiently to pass through a mesh screen of approximately 1,300 holes to the square inch.

Subsequently the ore is crushed in tube-mills to a powder so fine that it would pass through a screen having 40,000 holes per square inch. These tube-mills consist of large revolving cylinders containing huge stones, and the ore is reduced to the necessary fineness by the intense grinding action of the stones as the cylinders revolve.

The powdered ore is converted into a kind of slime by directing on to it a jet of water, and this slime passes over inclined tables composed of copper plates coated with mercury. An amalgam of mercury and gold is thus formed, and this is scraped off the plates and subjected to heat, which drives off the mercury in the form of vapour. The gold thus recovered is cast into solid bars, which may be worth as much as £3,000 each; and the mercury vapour is condensed ready for further use.

This process does not result in capturing the whole of the gold in the slime, but only about 60 per cent. of it. At one time the remainder of the gold was regarded as lost, but to-day some 96 per cent. of it is recovered. The "tailings," as the residue of the slime is called, are led to a big wheel called a "tailing wheel," having a series of buckets on its circumference. The wheel raises the tailings and then discharges them into vats containing a weak solution of cyanide of potassium. The contents of these tanks are thoroughly stirred by means of slowly revolving paddles, and chemical action takes place, resulting in the formation of cyanide of gold. This solution is now passed into small tanks containing zinc shavings. The cyanogen has a greater affinity for zinc than for gold, and therefore it releases the latter in order to combine with the zinc. The gold settles to the bottom in shining yellow particles, and at intervals this deposit is removed, smelted, and cast into solid bars weighing approximately $\frac{3}{4}$ cwt. each.

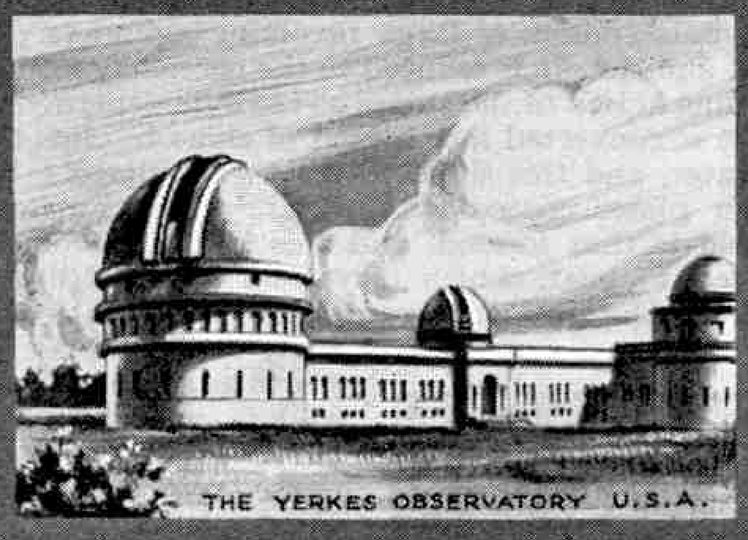
The tendency nowadays is to attach increasing importance to the tube-milling and slime treatment. It is even proposed to eliminate the stamp milling and the amalgamation entirely, and to extract the gold solely by cyanide treatment of the slime.



View of a Koffiefontein diamond mine, showing the surface plant.

During the 40 years of its existence, the Witwatersrand gold mining industry has treated about 700,000,000 tons of rock, from which gold to a total value of more than £930,000,000 has been extracted. The labour force in the Union, starting from small beginnings, has grown until now more than 21,000 Europeans and nearly 200,000 natives are employed in the gold mines.

The gold reef of the Witwatersrand extends to depths of from 8,000 ft. to 10,000 ft. below the surface. To-day the average working depth of the mines is close upon 3,000 ft., while the maximum depth of working is 7,600 ft. The future of this vast gold field depends upon the practicability of mining at great depths, and on the extension of the reef in the Eastern area, where there are possibilities of a large production. On account of the low rise of temperature with depth that prevails here, it should be possible to mine at considerably greater depths than have been attained in any other part of the world. The temperature rise with depth below the surface varies in different regions, the normal rise being about one degree for every 65 ft. of vertical depth. On the Rand, however, the temperature rises only at the rate of one degree for every 255 ft., so that conditions there are more favourable for mining at increasing great depths.



OUR WONDERFUL WORLD

The Great Ice Age Not Yet Ended

Thousands of years ago Northern Europe, including the greater part of Great Britain, was covered by immense glaciers, the greatest of which radiated southward from the mountains of Scandinavia. Gigantic ice streams also swept over North America, and descended the slopes of the Alps, the mountains of Central Africa and ranges in the Southern Hemisphere. It has been calculated that at one time the total area of land covered by ice was about 12,000,000 sq. miles. The earth's climate is now milder, but ice still covers 6,000,000 sq. miles of its surface. Apparently the Great Ice Age has not yet come to an end, therefore, although the great sheets of ice that once spread over enormous tracts have now broken up into mountain glaciers of the modern type.

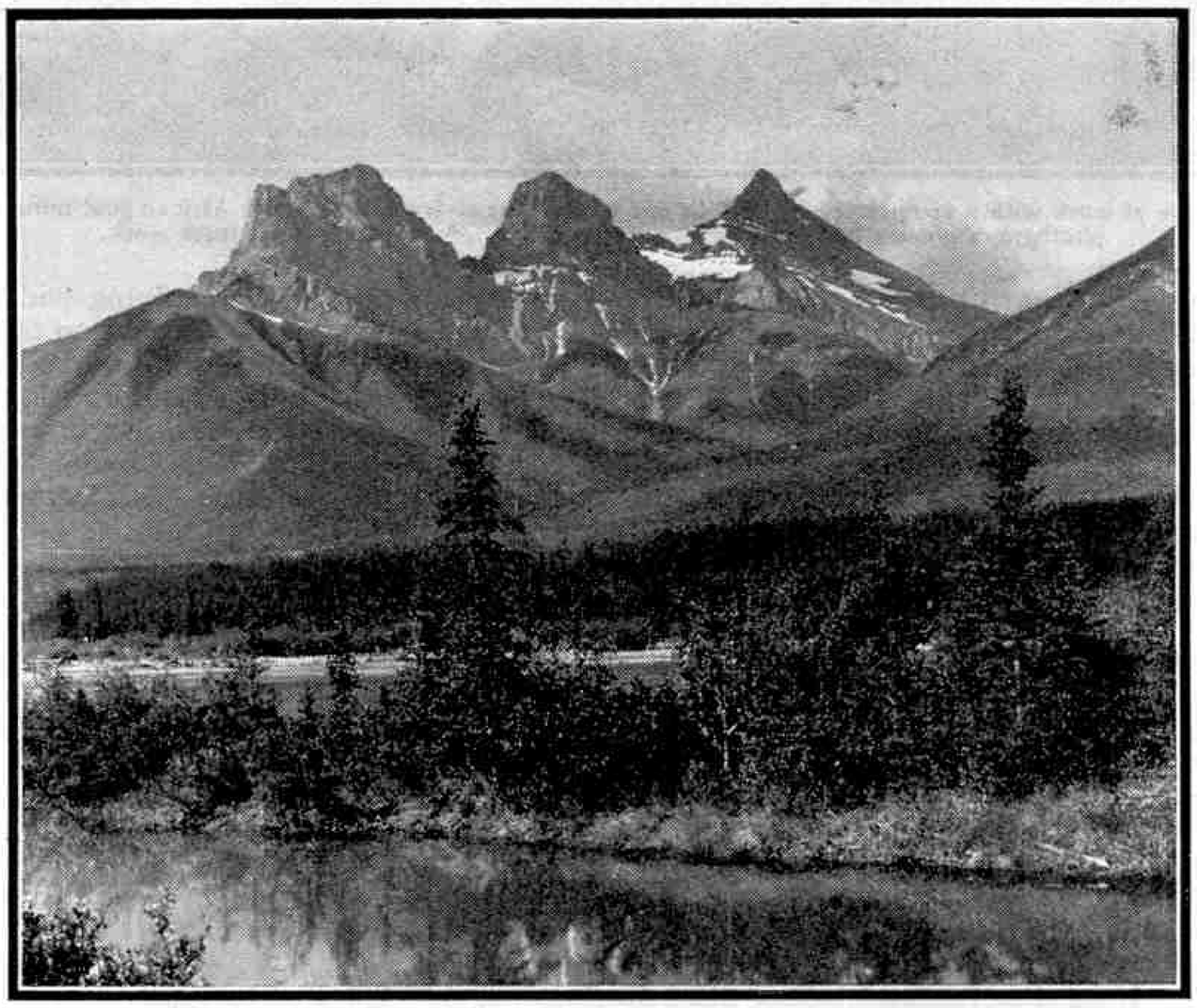
When the ice sheet of Northern Europe retreated, it did so very slowly, and on four or perhaps five occasions it spread outward again, as if reluctant to lose its grip. In many places the rate at which its edge moved northward has been measured by examining the layers of clay deposited in the lakes that marked its edges. The clay deposited in summer was coarser and more abundant than that laid down in winter and beds formed under these conditions thousands of years ago are in alternate layers of coarse and fine material that show how many years the pools remained at the edges of the prehistoric glaciers. Thus they tell us the ages of the beds themselves, exactly as the annular rings of a tree tell us the number of years during which it grew.

A regular succession of the clay beds in various places in northern Germany and in Scandinavia has been detected, and by a comparison of these it was found that the edge of the ice sheet retreated northwards at the average rate of a mile in 9½ years. Then came a dramatic discovery, for it was realised that at a certain place in Central Sweden the story told by the bands of clay was brought right down to historic times. By tracing these and corresponding bands in other parts of the country backward, what may be described as a calendar of the Great Ice Age has been obtained. From this we learn that the edges of the ice sheet left the southern shores of the Baltic Sea about 18,000 years ago, and that the site of Stockholm became uncovered about 8,000 years later. Central Sweden was still under ice 9,000 years ago.

Niagara Falls Changing Shape

Hundreds of tons of rock recently fell from the brink of the American Falls at Niagara, leaving a gap 150 ft. in width, and 200 ft. in depth. The rock that broke away now lies in a huge pile at the foot of the Falls near Goat Island, and the change in shape is the greatest that has occurred at Niagara within living memory.

It is scarcely surprising that a break has been made, for the remorseless action of the water undercuts the great ledge over which it pours. The ledge itself is of hard limestone that stoutly resists the action of the water. It rests on shale that is readily eroded, however, and as this is worn away portions of the ledge are left unsupported. From time to time large pieces break away and the brink of the Falls retreats a little upstream. This process has been in operation for about 32,000 years, and during that time the water has slowly eaten its way back for a distance of about seven miles, forming a deep gorge that now extends from Niagara to Queenston, halfway to Lake Ontario.



The Three Sisters Mountains in the Canadian Rockies. One of the three peaks is 9,744 ft. in height.

Greatest Meteorite Seen To Fall

Meteorites large enough to escape complete combustion during their passage through the atmosphere are seldom actually seen to fall, and the largest ever traced fell in Arkansas, U.S.A., early in 1930. It rushed across the sky in the form of a ball of fire and finally broke up with a terrific explosion. Three fragments are believed to have been formed, and two of these were found. One of them is small, but the second weighs 820 lbs., and made a hole 8 ft. in depth in the clay on which it fell. A portion of the meteorite was chipped off after its discovery, but the remaining mass weighs 745 lb., and has been safely placed in a museum.

It is interesting to note that practically all those who saw the Arkansas meteorite were convinced that it fell near them, although many of them were as far as 75 miles away from the place where it was found. Seeing a large meteorite always gives this impression to onlookers, people a hundred miles from each other involuntarily running out of the way in the belief that the ball of fire is about to strike them. An interesting feature of the fall of the meteorite was that it was mistaken by several observers for an aeroplane crashing to the earth in flames, and one eye-witness even sent a warning telegram to an aerodrome near which the alleged explosion happened.

Before the fall of the Arkansas meteorite the greatest body of this kind actually seen during its passage through the air fell in Czecho-Slovakia on 9th June, 1866. Its weight is 650 lb. Both this and the Arkansas meteorite are very much smaller than the one weighing about 50 tons that was discovered at Grootfontein in South West Africa, but the date when this giant struck the earth is unknown. The next largest meteorite was discovered in Greenland by Peary. Eskimos had succeeded in chipping off fragments for use as spearheads, but the remaining mass weighs about 36 tons. This meteorite is now in a New York museum. Two smaller meteorites were found near it, but like the Grootfontein specimen, none of these was actually seen to fall.

Reindeer Herds for Northern Canada

Contrary to the usual opinion the far north of Canada is not entirely a frozen waste, for there good pasturage may be obtained from thousands of square miles of country by animals specially adapted to life in sub-Arctic regions. Enormous bands of caribou, a wild species of reindeer, formerly inhabited the regions, and it is believed that at one time these animals numbered no less than 30,000,000. Until quite recently they supplied Eskimos and Indians with food and clothing, but unfortunately they cannot be relied upon to appear regularly. Slaughter by the Eskimos, now provided with rifles, has reduced their numbers considerably and the survivors have been driven to new feeding grounds, that at present are unknown to the inhabitants of the country or are beyond their reach.

In order to provide a substitute for the disappearing caribou, the Canadian Government has decided to introduce the reindeer, the well-known animal from Siberia and Northern Europe, which is domestic in habits and can readily be herded. It has already been established in Alaska, into which country a herd of 1,280 was imported as long ago as 1891. These have thrived to such an extent that to-day there are nearly 1,000,000 reindeer in Alaska, while at least 200,000 have been killed for their meat.

In pursuance of their plan the Canadian Government bought 3,000 reindeer in Alaska a few years ago, and these have been driven to the vicinity of the Colville River on the Arctic coast. Aeroplanes were employed to direct the course of the great herd, and the necessary camping equipment for the drovers was hauled on sledges to which reindeer were harnessed. The animals will be driven eastward and eventually settled on pasturage on the east side of the Mackenzie River. One large herd will make its home in an area of about 15,000 sq. miles near the Mackenzie delta. A second will be released on a grazing area north-east of the Great Bear Lake. This tract is 38,000 sq. miles in extent and is believed to be capable of supporting as many as 300,000 reindeer.

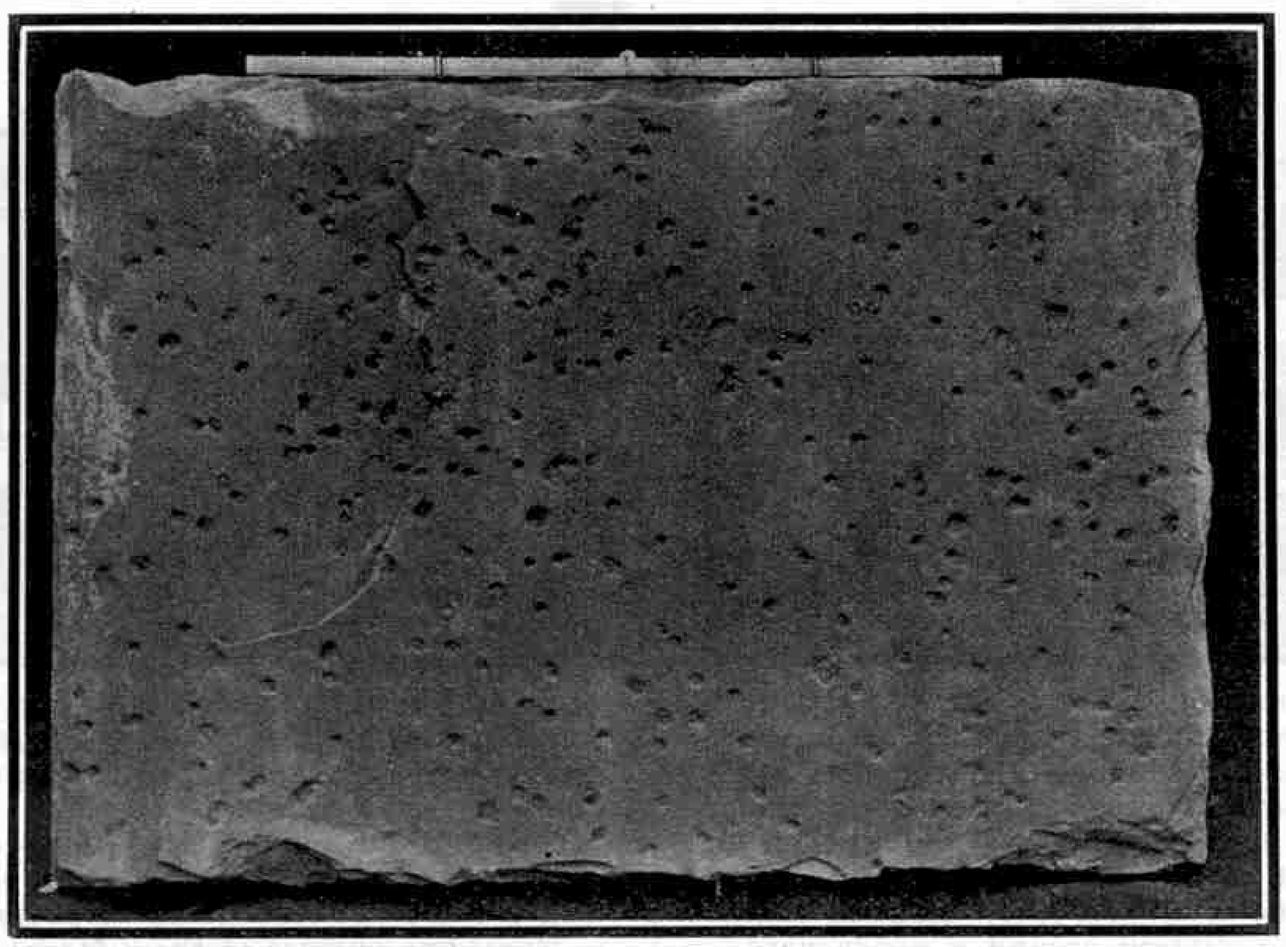
To the Eskimos the reindeer will be as useful as the caribou, for the meat obtained from them is excellent and their skins are suitable for making clothing. The animals will not be given to the natives individually, for there are no natural boundaries by means of which they can be divided into small herds. Instead community herds will be maintained by the tribes. It will be necessary to prevent indiscriminate slaughter, of course, but it is expected that Government supervision will be effective.

The interesting suggestion has been made that after the settlement of the reindeer, the caribou herds will again increase, for they will not be hunted so ruthlessly as formerly.

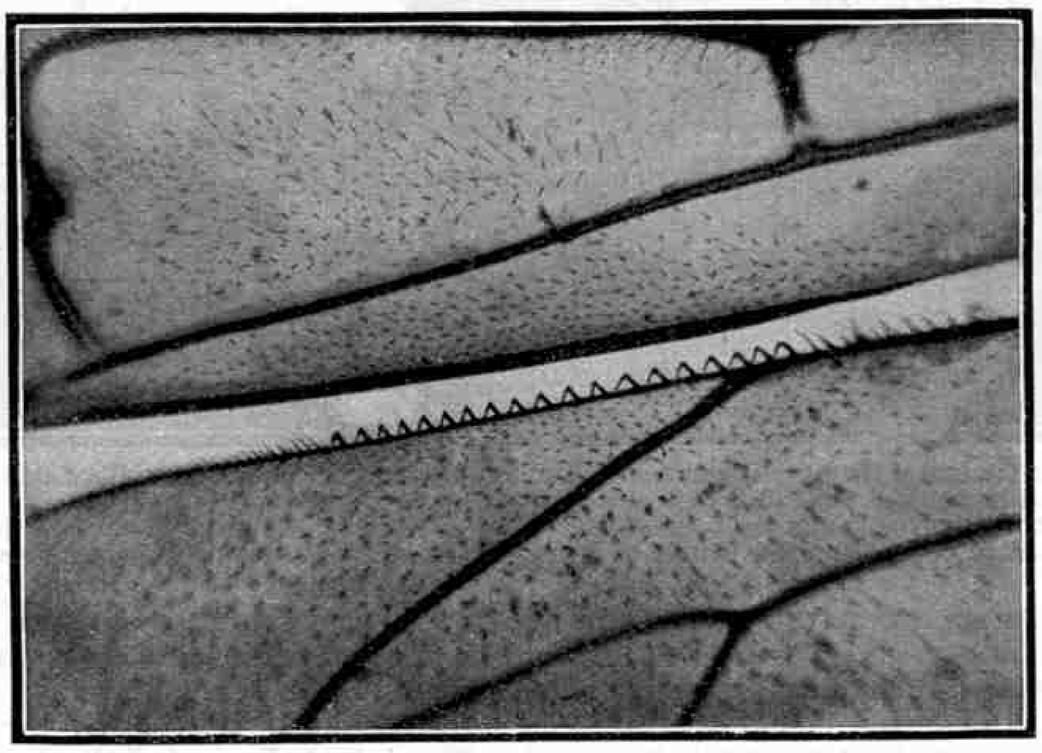
West Australia's Largest Nugget

Early in the present year memories of the gold rushes in Australia were revived by the discovery in West Australia of the largest nugget yet found in that State. It was encountered 18 in. below the surface by a boy 17 years of age, who with his father was at work in the new gold field discovered at Larkinville, near Kalgoorlie. The nugget weighed about 78 lb. and its total value is believed to be about £6,000. It has been called the "*Golden Eagle*," owing to its resemblance in shape to the figure of an eagle with outstretched wings. The gold field in which the nugget was discovered contains no alluvial gold.

The first gold nugget found in Australia weighed 1 lb. and was discovered in New South Wales in 1851. Among later Australian nuggets two of the most famous were the "*Welcome*," found at Ballarat in 1856, and the "*Welcome Stranger*," discovered 14 years later near Dunolly, these weighing 2,217 and 2,315 oz. respectively. They were obtained from alluvial gold diggings, but the largest mass of gold ever found in Australia weighed 630 lb. and was extracted from a quartz reef near Hill End, New South Wales, in 1872.



Tiny pits formed by raindrops of millions of years ago. The mud in which they were made has since been consolidated into rock and the impressions have thus been preserved.



A photo-micrograph of a bee's wing. A bee has four wings, and along the edges of two of them are tiny hooks, shown in our illustration, that catch in grooves in the upper ones when the insect is in flight.

Exploring Ocean Depths

The greatest depth in the sea reached by any human being is 1,426 ft., or a little more than a quarter of a mile. This record was made off Bermuda by Dr. Beebe, the well-known explorer of the depths of the ocean, and a representative of the American Museum of Natural History, for which the novel venture was conducted.

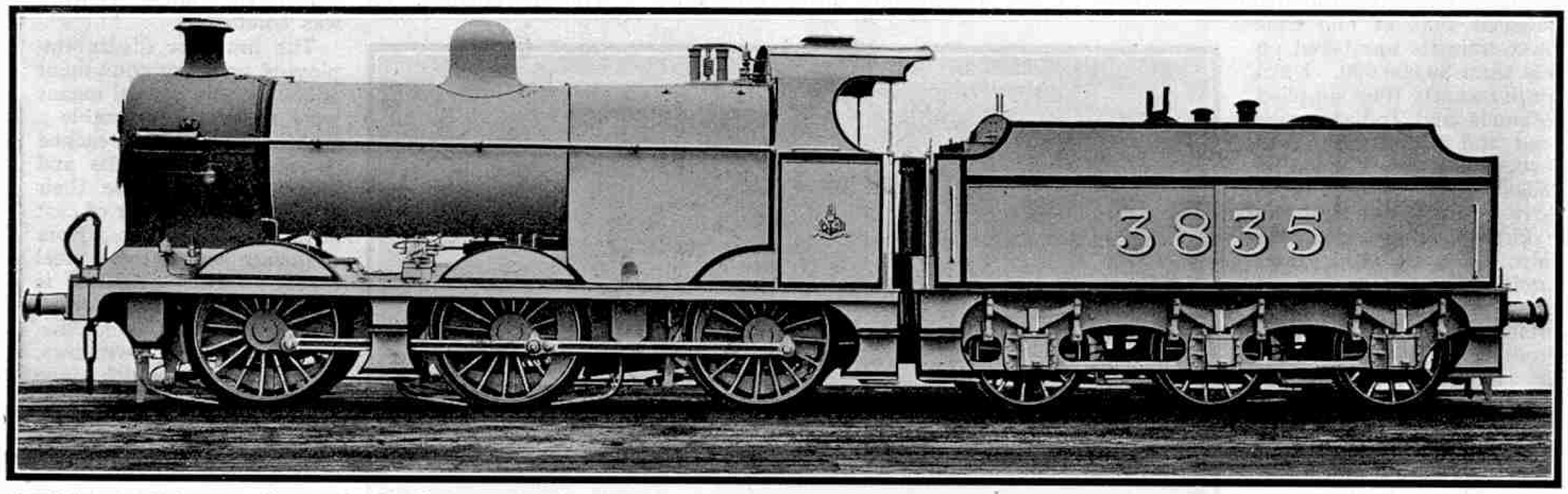
The limit for divers employing ordinary equipment is 350 ft., and special means were necessary to enable a greater depth to be reached n safety. Dr. Beebe and his companion made their descent in a cylinder of cast steel that was lowered from a surface vessel by a steel cable. The cylinder is equipped with oxygen apparatus and a telephone. It has three windows, through two of which shine powerful electric lights supplied with current by means of cables from the parent ship. The light from these enables the occupants of he cylinder to make observations and take photographs through the third window.

At a depth of 1,400 ft. sea-water exerts a pressure of about 1,200 lb. per sq. in. As the windows are eight inches in diameter, each is called upon to withstand a force of nearly 27 tons, therefore, and the provision of suitable material for them was one of the difficulties encountered in designing the cylinder. Plate glass three inches in thickness would be strong enough, but it would have a cloudy greenish tint and vision or photography through it would be out of the question. Fortunately fused quartz was available. This is made by melting natural quartz, an operation that requires a high temperature and demands great skill on the part of those conducting it. The occupants of the cylinder are able to see through thick windows of this material as readily as through an ordinary thin glass window on land, and through it Dr. Beebe obtained satisfactory photographs of the bottom of the ocean near Bermuda.

The discs of fused quartz were prepared in the Elihu Thomson research laboratory of the General Electric Company of New York. This laboratory is situated at West Lynn, Massachusetts, where the difficulties of fusing the material have been solved after prolonged experimental research. Fused quartz is now employed in making mirrors for reflecting telescopes, and in the same laboratory enormous discs of it are being prepared for the gigantic mirror of the 200 in. reflector for the Californian Institute of Technology. When completed this telescope will be by far the largest in the world, the 100 in. reflector at the Observatory on Mount Wilson in southern California being at present the world's largest.

Fused quartz is now largely used instead of glass in making dishes and crucible that are to be very strongly heated.

Engines in "Black Coats"



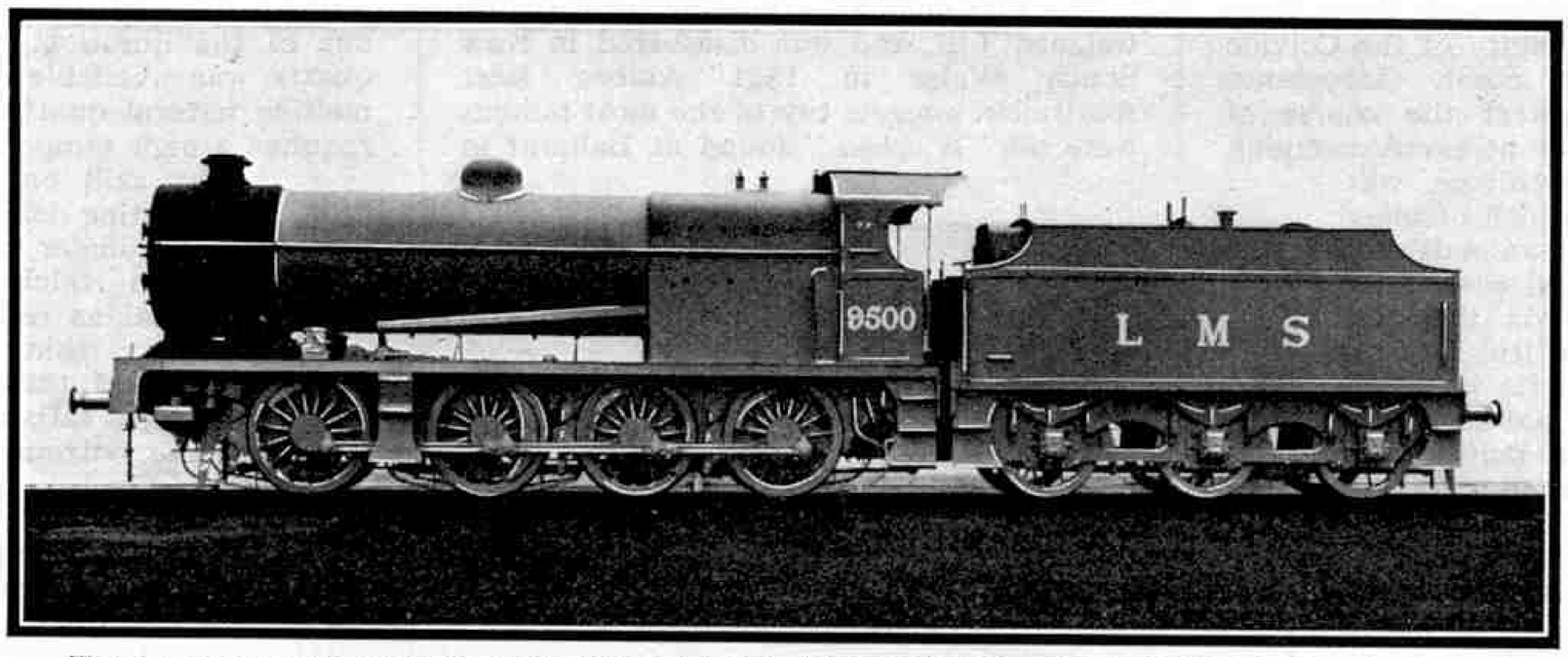
THE goods locomotive undoubtedly attracts far less attention and is much less popular than the passenger locomotive, and two reasons for this are obvious. In the first place he is usually condemned to wear a black coat—often a very dingy one—and in addition most of his work is carried out in such an inconspicuous manner that it is apt to be unnoticed. Even less consideration is given to the small and fussy shunting engine that seems to spend his days pottering around a goods yard—apparently going and coming back in an erratic and aimless fashion. Yet to the shunting engine is entrusted the responsible task of keeping the great marshalling yards supplied with wagons. During the course of his life the "shunter" covers many thousands of miles in his little area, but he never comes into the limelight, and even by railway enthusiasts he is apt to be overlooked.

Although we are apt to look upon the driver of an express passenger locomotive as a superior being to his fellow driver on goods work, it is a fact that the driving of a goods engine has certain difficulties of its own and requires both skill and judgment. For instance, most goods wagons are fitted with loose couplings. The consequence of this is that when up-gradients are encountered the train stretches out and the couplings tighten. The engine driver therefore must exercise the greatest care otherwise couplings will snap and the result will be a broken train. Again on a down-gradient great care must be taken to avoid a heavy goods train getting out of hand. In most cases there are only the engine and tender brakes and those of the guard's van, the latter being operated by hand. On such occasions also the guard of a goods train must exercise great care and discretion otherwise the application of his brakes may result in the train parting in the middle. If this happens the engine driver will probably not realise that he has only half his train behind him until the bottom is reached and the engine re-commences steaming, when the lightened load is plainly indicated by the manner in which the engine accelerates. Then, of course, the driver will pull up to investigate matters. In the meantime the other half of the train may succeed in overcoming the pull of the brake van and come thundering down the incline with the inevitable result of a serious crash.

Goods engines are divided into the usual two main classes, tank and tender. These types may be further subdivided into mixed traffic engines; heavy goods engines (most of which are tender engines); engines of the light goods type; and the yard engine or small shunter.

Mixed traffic engines are employed on both heavy passenger and express goods services with equal success and the 2–6–0 and 4–6–0 types seem to be those most favoured.

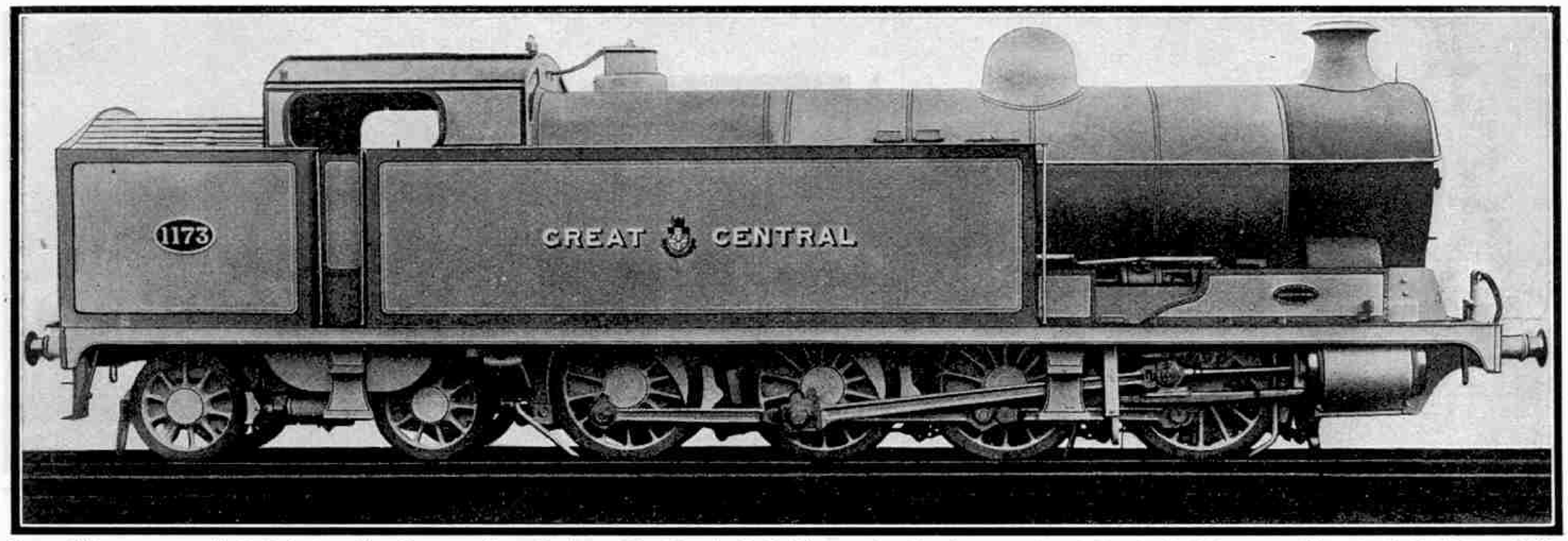
Many fine engines of the "Mogul" type that were built to the design of Mr. H. N. Gresley, for the Great Northern Railway, are now in service on the London and North Eastern Railway. These exceptionally fine engines performed wonders on the 18–20 coach passenger trains between Doncaster and London, prior to the "Pacific" era. It was by no means uncommon to find them hauling tremendous passenger loads with fast timings one day, and on the next to see them at the head of goods trains of from 800 to 1,000 tons, excluding tenders. In spite of the wheels being only 5 feet 8 inches in diameter, they have attained speeds of 60, 65, 70, and even 76 m.p.h., and have been surprisingly steady all the while. The lines of these engines bear a striking resemblance to those of the "Pacifics." Further examples of the class have been built since grouping, the original Great Northern design being modified by the addition of large double-window cabs, new tenders and reduced boiler mountings, to suit the Northern loading gauge They are known as the "K3" class of the L.N.E.R.



The photograph at the top of the page shows a L.M.S.R. 0-6-0 goods locomotive of Midland design. Large numbers of similar engines, suitably modified, have been built since grouping, and 722 are now in service.

The lower photograph is of the first of the L.M.S.R. standard 0-8-0 mineral engines. These have been developed from existing engines of L.N.W.R. design, the same pattern of boiler being used, but working at a higher pressure.

The Southern Railway have their famous Billinton "Moguls" (the late L.B. and S.C. Railway design), and also the Maunsell 810 Class (late S.E. and C.R. design), and these continue to do excellent work. There are also a number of 2–6–0 engines that were formerly the 2–6–4 tanks of the "River" Class, and some additional engines of the same design as the reconstructed ones. They have 6 ft. diameter driving wheels and are employed a great deal on excursion work. On the G.W. Railway and L.M.S. Railway considerable numbers of this type of engine are daily keeping schedules that are far from easy with heavy trains of both freight and passengers. The "43" Class of the former railway is famous for its ability to handle anything that comes along, while the new L.M.S. "Moguls" are to be seen daily performing feats of



One of the mammoth 0-8-4 shunting locomotives designed by Mr. J. G. Robinson for the former Great Central Railway. They were built specially for " hump " shunting service at Wath-upon-Dearne, and have three cylinders.

strength in goods yards as well as fast running with heavy passenger trains.

The 4–6–0 mixed traffic locomotives of the late L.N.W., Caledonian and G.C. Railways are also noteworthy, as well as the 2–8–0 mixed traffic " Consolidation " " 47 " Class of the G.W.R., which is renowned for its speed capabilities. There is also a numerous class of 4–6–0 locomotives on the G.W.R., known as the " Hall " Class. They have 6 ft. diameter driving wheels and are very useful for general purposes. The design originated in the substitution of 6 ft. wheels for the original 6 ft. 8½ in. wheels on one of the passenger locomotives " Saint Martin."

We come next to the heavy goods engines, which are usually fitted with tenders. In order that the maximum amount of adhesion may be obtained from engines designed to deal with this kind of traffic, driving wheels of very small diameter are used. It is a case of sacrificing speed for power. This will be made clear if we imagine two similar engines, one fitted with small driving wheels and the other with large ones. The one with the smaller wheels will be capable of exerting a greater drawbar pull than the one with the larger wheels because, although the same amount of energy per revolution is transmitted to both the large and the small wheels, the former revolve many times more than the latter over a given distance.

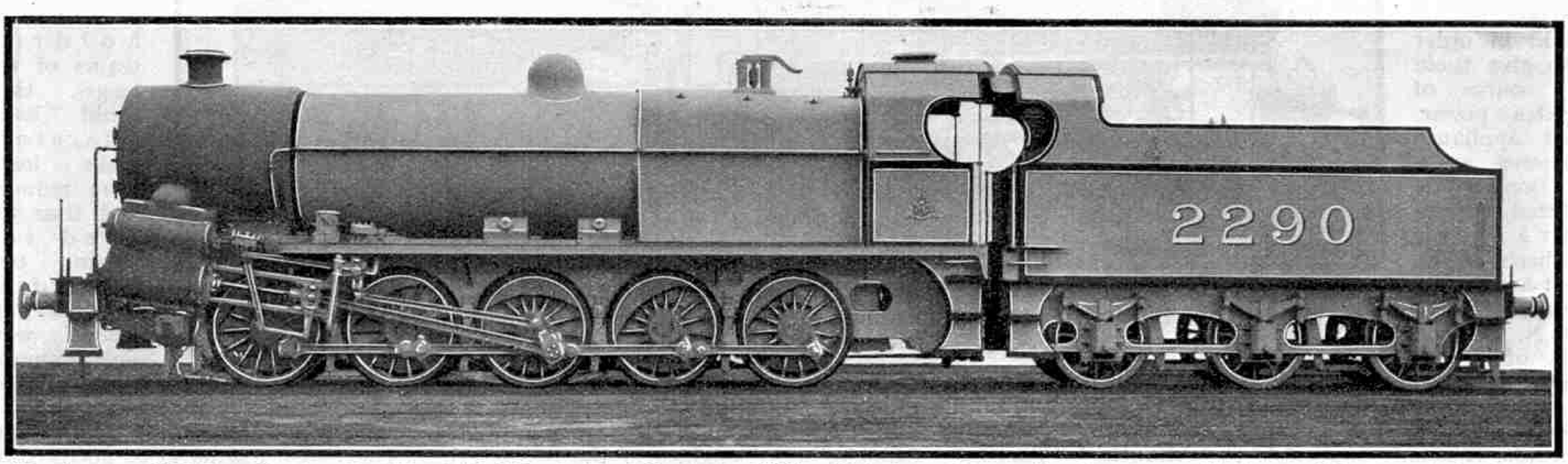
It should not be thought that a large number of small driving wheels coupled up together with coupling rods is prohibitive of high speeds, as in several cases engines of the 0–8–0 and 2–8–0 types have been known to attain speeds of over 60 m.p.h. Indeed, some of our modern fast goods trains are very frequently seen travelling at a good 45 m.p.h. or over.

The famous " Horwich " 0–8–0's of the L.Y.R., the " Crewe " 0–8–0's of the L.N.W.R., and also those of the G.C.R., have done some splendid all-round work on the heaviest of mineral trains. The latest development of the type are the new L.M.S. Standard 0–8–0 mineral engines, 100 of which were built during 1929. Further additions to the class have been made.

The 2–8–0 or " Consolidation " is certainly the locomotive that has become most popular for mineral train working in this country. The type originated in America, where an 8-coupled engine fitted with a leading pony truck was designed just after the Lehigh and Mahanoy Railroads had amalgamated to become the Lehigh Valley Railroad. It was built at the Baldwin Locomotive Works and was named the " Consolidation " to commemorate the occasion of the amalgamation of these two railway companies. It gave such satisfaction when hauling great weights of coal up gradients several miles in length, averaging 1 in 39, that the type gained favour not only in America but also in most other countries where heavy mineral work had to be contended with.

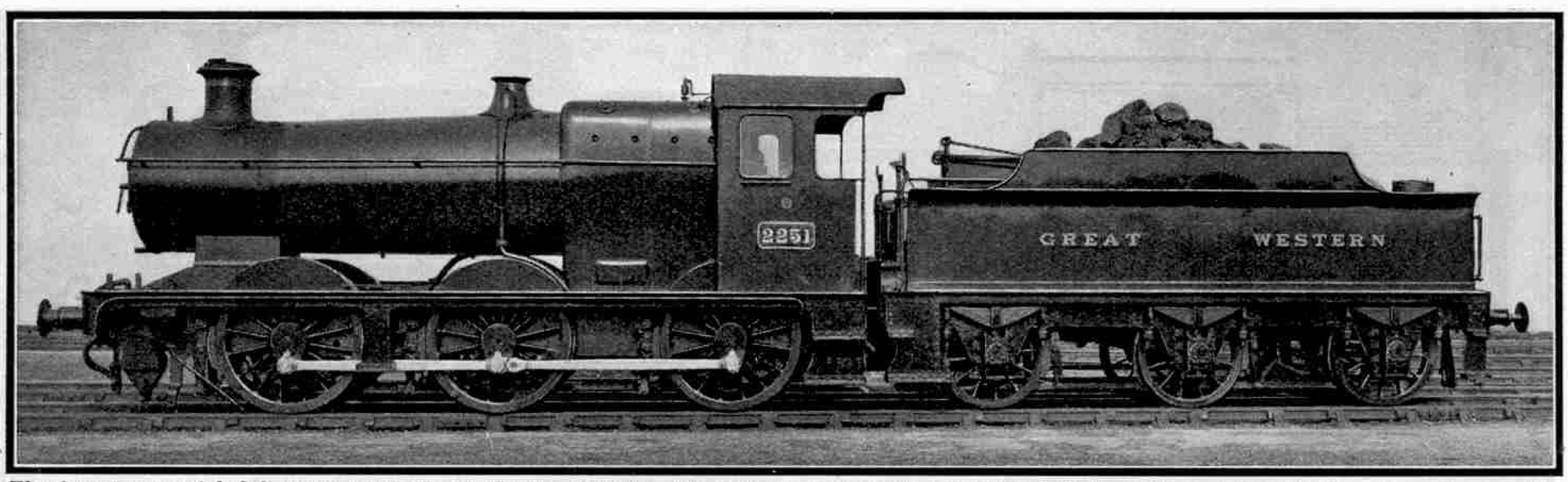
Considering the success of the " Consolidation " in 1866, it is extraordinary that this type of locomotive did not make its appearance on any British railway until 1903, some 37 years later on.

It was due to Mr. Churchward of the G.W.R. that the first 2–8–0 locomotive eventually appeared in England. The engine was numbered 97, and was expressly designed for heavy, fast coal train working in the South Wales mining district. Further examples of the G.W.R. 2–8–0 class were built in due course, and these are known as the " 28 " Class. In a special test with No. 2806 it was found possible to haul a train of 100 loaded coal wagons from Swindon to Southall. The usual load is 80 from Swindon to Old Oak Common, but the trains of returning empties are sometimes made up to 100 wagons. Later, in 1919, Mr. Churchward produced No. 4700, a 2–8–0 locomotive intended for mixed traffic working, and therefore fitted with larger driving wheels than the earlier mineral engines. This engine and eight others are the only " Consolidation " mixed traffic locomotives in the country.



The famous " Lickey Banker " of the L.M.S.R., built at Derby in 1920. This huge locomotive has four cylinders and ten coupled wheels. The tender cab is an interesting feature, and affords improved accommodation for the crew when the engine is travelling backward.

In 1905, the L.N.W.R. converted some 0–8–0's into " Consolidations " and these also proved successful. The reason for this conversion was that excessive weight was being carried on the leading driving axle, and a pair of small leading wheels was therefore added, making the engines 2–8–0's. The famous Great Central 2–8–0's, introduced in 1911, were soon handling tremendous weights with comparative ease, and in 1913 the 2–8–0's designed by Mr. Gresley and built at Doncaster Works were establishing themselves on the G.N.R. between Peterborough and London. In 1918 a three-cylinder engine of this type was constructed, and this design was further multiplied in 1921. The Great Central engines were designed by Mr. J. G. Robinson,

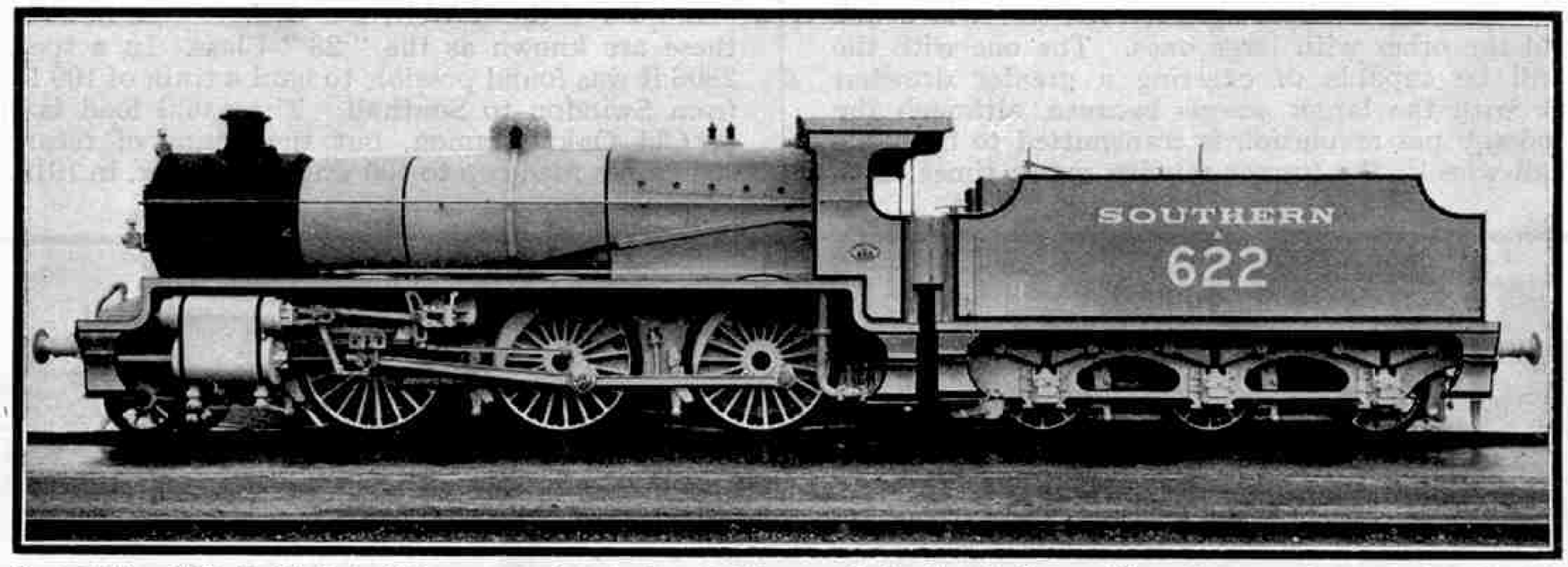


The latest type of 0-6-0 goods locomotives on the G.W.R. These have been built for duty on both main and branch lines, to replace earlier locomotives withdrawn from service.

Chief Mechanical Engineer, and were built at their Gorton Works near Manchester. It was this design that was adopted by the Government for the numerous R.O.D. (Railway Operating Division) locomotives that were built by various British firms specially for War work. After the War these engines were mostly bought up by our own railways though some have been sent as far away as to China.

The first "Mikado" ever built was ordered by the Japanese Imperial Railways and was constructed at the Baldwin Locomotive Company's Works. It was named "Mikado" in honour of the Japanese Company, and since then all 2–8–2's have been known as "Mikados." When ordering, the Imperial Railways stated that the engine was required to be capable of hauling extremely heavy loads, but that it was intended to feed it on rather poor quality fuel. For this reason the builders decided to enlarge the firebox and in doing so found it necessary to add a pair of carrying wheels under the cab.

Since 1925 the L.N.E.R. have had two 2–8–2's or "Mikados" built and these are the first of their kind in this country. They are intended for very heavy goods traffic, and in order to give them a source of extra power, an appliance known as a "Booster" is fitted to the trailing wheels. The standard type of large G.N. fire-box is of course ideal for this engine and is spread out over the trailing wheels.



One of the S.R. "Moguls" for excursion train working and similar duties. These locomotives are fitted with 6-ft. driving wheels to enable them to maintain higher speeds than the previous mixed-traffic engines with wheels of 5 ft. 6 in. diameter.

The booster, which is an American invention, can be applied to engines of any kind, so long as they have trailing wheels. In other words, it is only applicable to "Atlantic," "Pacific," "Mikado," "Prairie" and similar types of locomotives, as all of these have "idle" trailing wheels underneath the cabs. The booster arrangement enables the idle wheels to be converted into very effective driving wheels at times when the maximum amount of power is required.

The booster mechanism consists of a small separate and independent engine fitted beneath the cab and driven by two small cylinders, usually about 10 inches in diameter and with a stroke of about 12 inches. The steam is supplied directly from the boiler to the cylinders. When the locomotive is starting, the high tractive effort exerted by these small temporary driving wheels gives it very useful assistance. This auxiliary driving unit is arranged like the free-wheel of a bicycle and can be cut out as soon as the engine is travelling at about 25 m.p.h. The London and North Eastern Railway is at present the only British railway that favours the booster. Originally the Great Northern type "Atlantic" No. 4419 was the only booster-fitted locomotive in this country, but when the 2–8–2's were introduced for goods traffic working it was decided to equip these engines also with this very effective invention. The well known locomotive No. 10000 is also thus fitted. In America the booster is very popular and the tenders of "switching" engines are often fitted with a booster driven bogie. There appears to be a future for it also in this country.

The idea of providing an ordinary engine with some form of additional hauling power that could be called upon as required is not entirely new even in this country. Many years ago a few locomotives belonging to the Great Northern Railway were fitted with "steam tenders" designed by Mr. Sturrock. These tenders were mounted on underframes similar to those used on locomotives and were completed with cylinders, valve motion, etc., and mounted on six coupled wheels. They were thus equivalent to separate 0–6–0 locomotives except that their cylinders were supplied with steam from the boilers of the locomotives. These "double engines" were certainly capable of exerting very much more power than the ordinary type, but they proved unsuccessful on account of the fact that the average locomotive boiler of those days was not capable of maintaining a sufficient head of steam to keep the cylinders of both locomotive and the tender supplied effectively. The extra power obtained was to some extent the cause of their undoing, for the sidings of that time were not capable of holding trains of the length they could haul. Therefore train loads were reduced and thus the need for steam tenders disappeared. They were not popular with the drivers, who objected to having, as they said, two engines to look after.

Coming now to light goods traffic we find that this is entrusted to engines of the 0–6–0 type. The 0–6–0 engine is to goods train working what the 4–4–0 is to passenger train operation. It not only deals with all kinds of moderately heavy goods and mineral work but also is often to be seen taking a turn on a passenger train. There are great numbers of engines of this kind now handling goods services all over the country, although most of them are comparatively small. The large 0–6–0 goods locomotives of the L.M.S. Class 4 (Midland Section), the L.N.E.R. "J 39" Class, as well as those of the late Great Eastern Railway, are typical examples of these "handymen" of the line. Some fine examples of the type have also been built recently by the G.W.R.

In the British Isles there is only one engine with more coupled wheels than eight and that is the 0–10–0 banking engine of the L.M.S. This "Decapod" was built by the Midland Railway for the purpose of banking trains up the two miles at 1 in 37 of the Lickey Incline between Blackwell and Bromsgrove on the Bristol and Birmingham route. This banking, otherwise requiring the services of two 0–6–0 tank engines coupled together, is carried out with perfect success by the 0–10–0.

(Continued in the third column of next page)

A Railway with Riderless Cars

Remote Control of Rock-Carrying Line

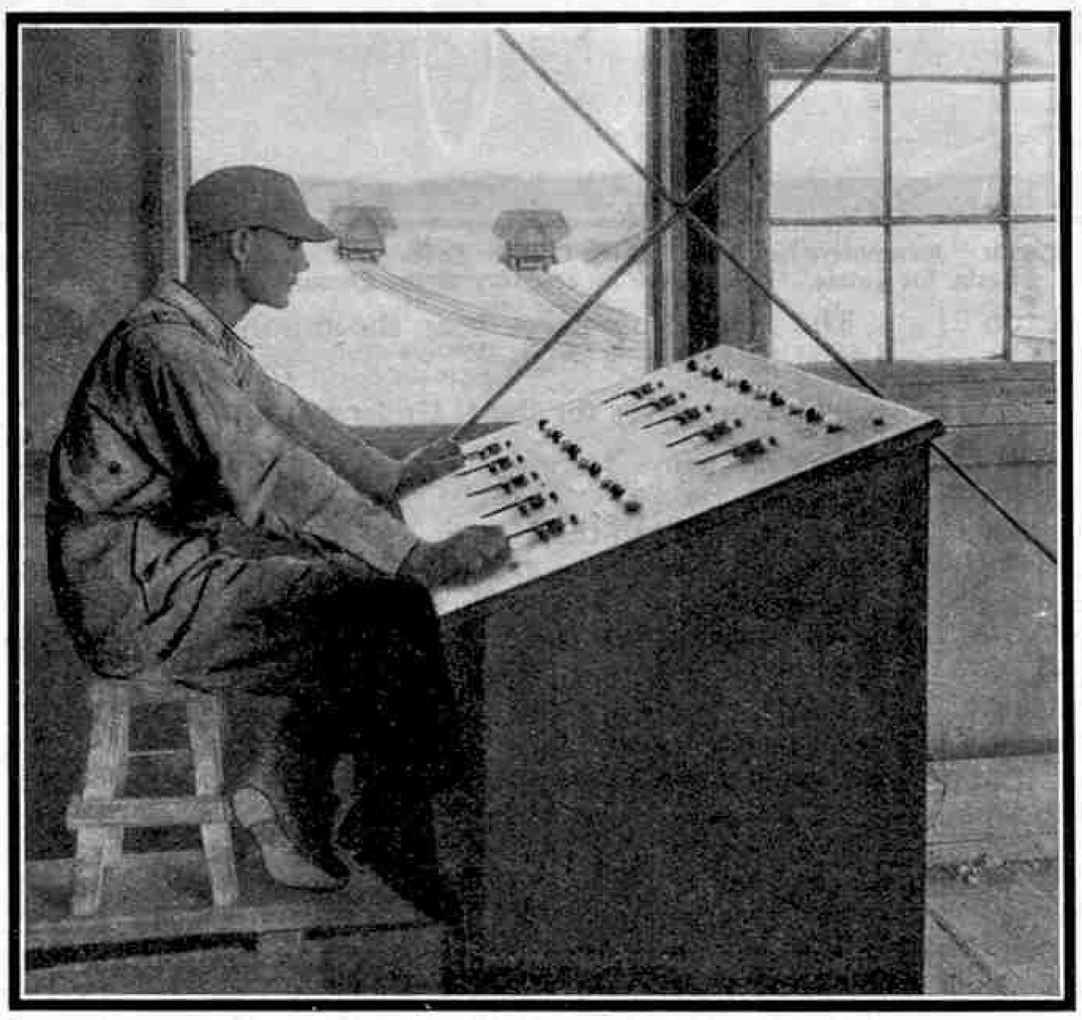
AT Dallas, Texas, U.S.A., there is a railway on which cars transfer cement rock from the excavating pit to the crusher over a mile away, apparently without any human direction. Nobody rides on the cars, and these move from place to place, starting and stopping as if possessed of an intelligence of their own. This unique railway, which is owned by the Trinity Portland Cement Plant, operates by means of a special method of electric remote control devised by the General Electric Company of New York. Each car is equipped with two 50 h.p. squirrel-cage motors with electric solenoid brakes, and no other control device of any kind.

The track on which the cars run is divided into a number of sections insulated from each other. The motor-driven cars collect their energy from an extra rail system, and two operators, who are situated where they can view the loading and unloading of the cars and their movements, control the delivery of current to each section of track by means of switches on control decks in front of them. When all the sections are energised, a car runs from one end of the track to the other. When one section only is energised, the car runs through that section to the next where, on the electric supply being cut off, the brakes automatically come into action and stop the car. By applying energy to a section momentarily, cars can be moved along a short distance at a time; and they will not coast indefinitely on a dead track section because of the automatic action of the brakes. The direction of travel is changed simply by the movement of a switch.

An interesting feature of the installation is the conservation of power made possible by the use of squirrel-cage induction motors, an important characteristic of which is that they tend to maintain constant speed in all circumstances. On down grades gravity will not materially speed-up the cars, but will be automatically converted into electric current, for the motors will then act as generators. The power then generated will be fed back into the power system, thus helping to operate other cars on other sections of the track. In this way effective and constant speed limitation is secured along with the greatest economy in the consumption of current.

This railway has many features of interest, and it appears to be particularly well suited for use at quarries where the excavated material has to be conveyed a considerable distance to the place at which the next operations are carried out. The system should be both rapid and economical in working, an important point being that there is no time lost by men having to accompany the cars on their journeys.

Motor-driven riderless cars on a remote controlled railway at Dallas, U.S.A. For our illustrations we are indebted to the General Electric Company, New York.



An operator controlling the delivery of current to various sections of the track by means of switches on the control desk in front of him.

Engines in "Black Coats"—

(*Continued from page 788*)

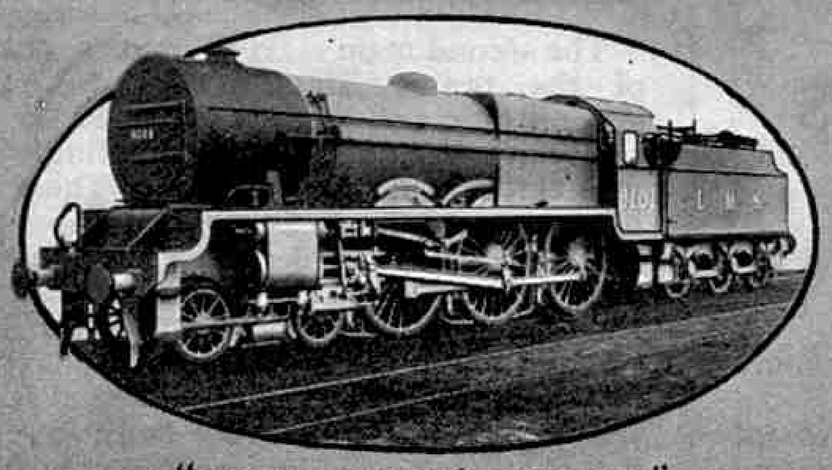
The second main class of engines consists of the tanks. The smallest tanks in general use are the 0–4–0's. These are rarely ever seen outside the shunting yards in which they spend their lives. There are, however, quite considerable numbers of 0–4–2 and 2–4–0 tanks to be seen working daily both on goods and on light passenger trains especially on the G.W.R. The 0–6–0 wheel arrangement is greatly favoured for shunters and engines for local goods trains, while their larger editions, the 0–6–2's, are even more in evidence on all railways. The honour of being the first engine in this country to have a Belpaire firebox belongs to a 0–6–2 tank engine, No. 515, of the late Great Central Railway.

Tank engines of the 0–6–4 type are usually employed on passenger work and perhaps would be more correctly termed mixed traffic tanks. Some exceptionally fine locomotives of this type were built by the late Midland and North Staffordshire Railways, and are giving most satisfactory results on present-day L.M.S. services.

The 2–6–2 or "Prairie" type tank engine is particularly favoured by the Great Western Railway, several classes being in service. The chief of these is perhaps the "51XX" Class which is the tank edition of their tender 2–6–0 "43" Class mentioned previously. It performs very similar duties with equally good results. The L.M.S.R. also has a number of engines of this wheel arrangement, and the type has recently been adopted by the L.N.E.R. The two latter classes are used mostly on passenger work, but those of the Great Western are used also for goods traffic.

The 0–8–4 engines built by Mr. J. G. Robinson of the late G.C. Railway for the Wath Concentration Sidings are also well known in the shunting world, as they seem to have set the fashion for large 8-coupled tanks fitted with leading or trailing bogies. The North Eastern Railway had 8-coupled tank engines for similar work, though instead of four trailing wheels they had four leading wheels, and were therefore of the 4–8–0 type. They are still in service, being now, of course, the property of the L.N.E.R. Some are employed at Whitemoor Marshalling Yard as they are specially suited to "hump" shunting work.

Mr. Urie (of the late L.S.W.R.) designed some similar engines for the new goods yard at Feltham, and there were also thirty 0–8–4 tank engines built at Crewe for hauling heavy goods trains at Abergavenny and between the Liverpool Docks and Edge Hill. These engines are found very efficient for work on the famous "gridiron" at Edge Hill.



RAILWAY NEWS

New "Super-Pacifics" on the Nord Railway

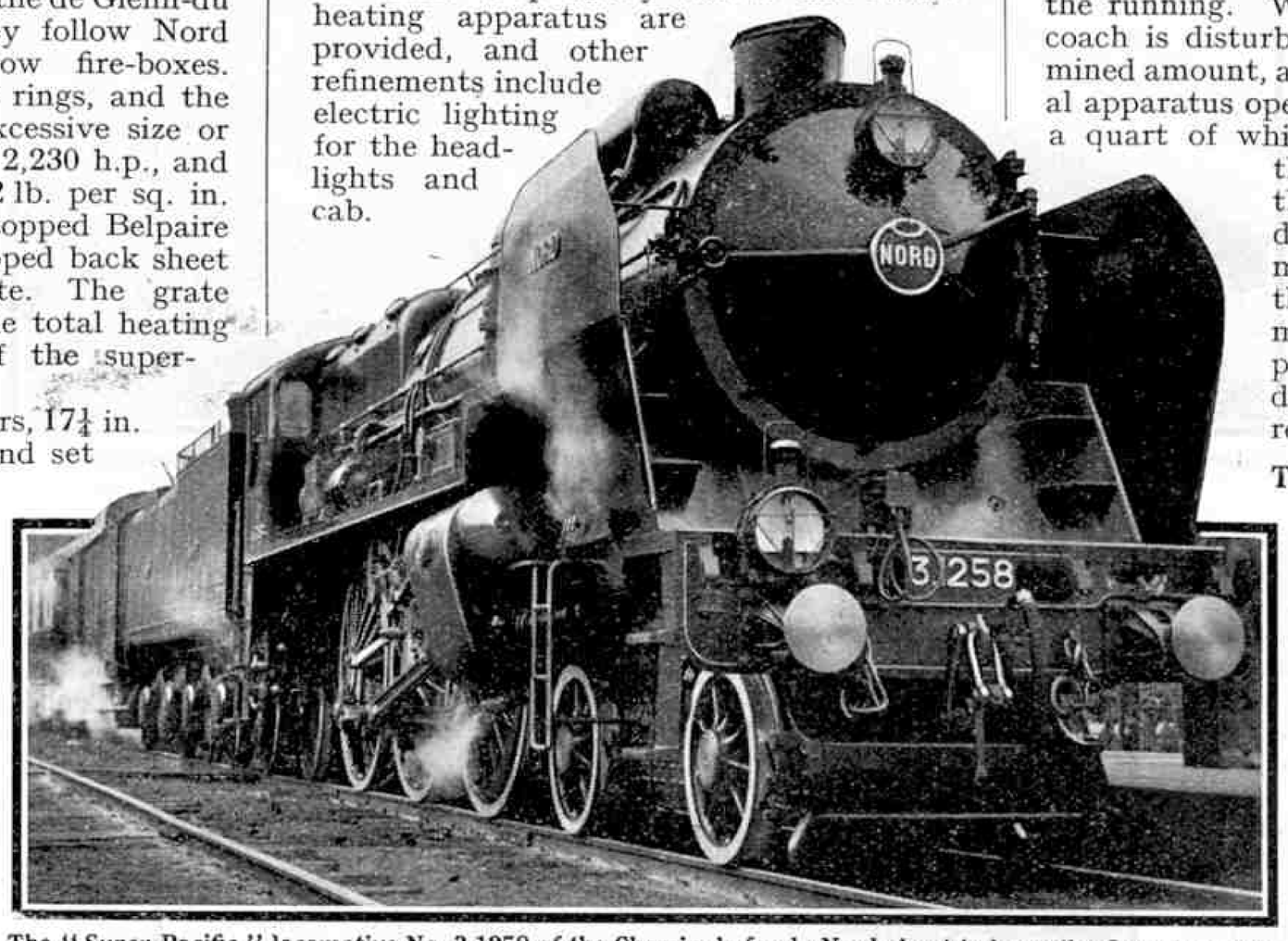
The accompanying photograph shows locomotive No. 3.1258 of the Chemin de fer du Nord, Paris, about to leave the Gare du Nord for Calais. This is one of the latest "Pacifics" built for the "Nord," and 40 of the type are in service. They are a development of the "Super-Pacifics" of 1923, which in turn were evolved from smaller engines. They resemble the majority of French express locomotives in being superheated compounds on the de Glehn-du Bousquet system, but they follow Nord practice in having narrow fire-boxes. The boiler barrel is in two rings, and the boiler, without being of excessive size or unusual design, is rated at 2,230 h.p., and works at a pressure of 242 lb. per sq. in. The fire-box is of the flat-topped Belpaire type, and has a slightly sloped back sheet and steeply inclined grate. The grate area is 37.7 sq. ft., and the total heating surface, including that of the superheater, is 2,928 sq. ft.

The high-pressure cylinders, 17¼ in. in diameter, are outside, and set back over the rear bogie wheels; they drive the middle pair of coupled wheels. The inside low-pressure cylinders, 24½ in. in diameter, are set further forward over the bogie centre, and drive on the leading coupled axle. This large diameter for inside cylinders has necessitated the cutting away of the frames to accommodate them, and as compensation, steel castings of special design are applied at this point. The piston stroke of the high-pressure cylinders is 26 in., and that of the low-pressure cylinders 27 in. The driving wheels have a diameter of 6 ft. 2¾ in.

Piston valves are used to distribute the steam in the outside cylinders, and slide valves for the inside cylinders, operated by separate sets of Walschaerts valve gear. As these are separately controlled in accordance with the de Glehn-du Bousquet system, the cut-offs in the high-pressure and the low-pressure cylinders may be varied at will. The engine may be worked temporarily as a four-cylinder simple.

In order to assist in the dispersal of smoke and steam the chimney is wedge-shaped in front, and smoke deflecting side sheets are provided. Feed-water heating apparatus of the A.C.F.I. pattern is fitted, and one of the drums behind the chimney, and the pump on the platform above the driving wheels, are shown in the illustration. This apparatus was dealt with in the *"M.M."* for February, 1930.

The latest pattern high-capacity tenders are used, running on four-wheeled bogies fitted with "Isothermos" axle-boxes. They carry nine tons of coal and 8,140 gallons of water, which is sufficient for 200 miles running without re-fuelling under the heaviest conditions of load. The engines weigh 99 tons in working order of which 55.9 tons are available for adhesion. Pop safety valves and steam heating apparatus are provided, and other refinements include electric lighting for the head-lights and cab.



The "Super-Pacific" locomotive No. 3.1258 of the Chemin de fer du Nord about to leave the Gare du Nord, Paris, for Calais. Photograph by courtesy of the Chemin de fer du Nord.

The new locomotives bear the numbers 3.1251-3.1290.

New Locomotives for the "Underground"

Two steam locomotives have been supplied by the Hunslet Engine Co. Ltd., of Leeds, to the Metropolitan District Railway. They are 0–6–0 tank engines. The locomotives are being used on the new works that are now in progress and will afterwards be employed on general shunting duties. They have wheels 4 ft. 2 in. in diameter and two outside cylinders of 18 in. diameter and 24 in. stroke. The total heating surface amounts to 852 sq. ft.; the grate area is 14.5 sq. ft. and the working pressure 200 lb. per sq. in.

The side tanks carry 1,200 gallons of water and the back bunker holds 30 cwt. of coal. The weight in working order is 44 tons.

They are numbered L30 and L31, and are painted crimson, with *"Underground"* in gilt lettering on the tank sides.

The "Whitewash" Coach

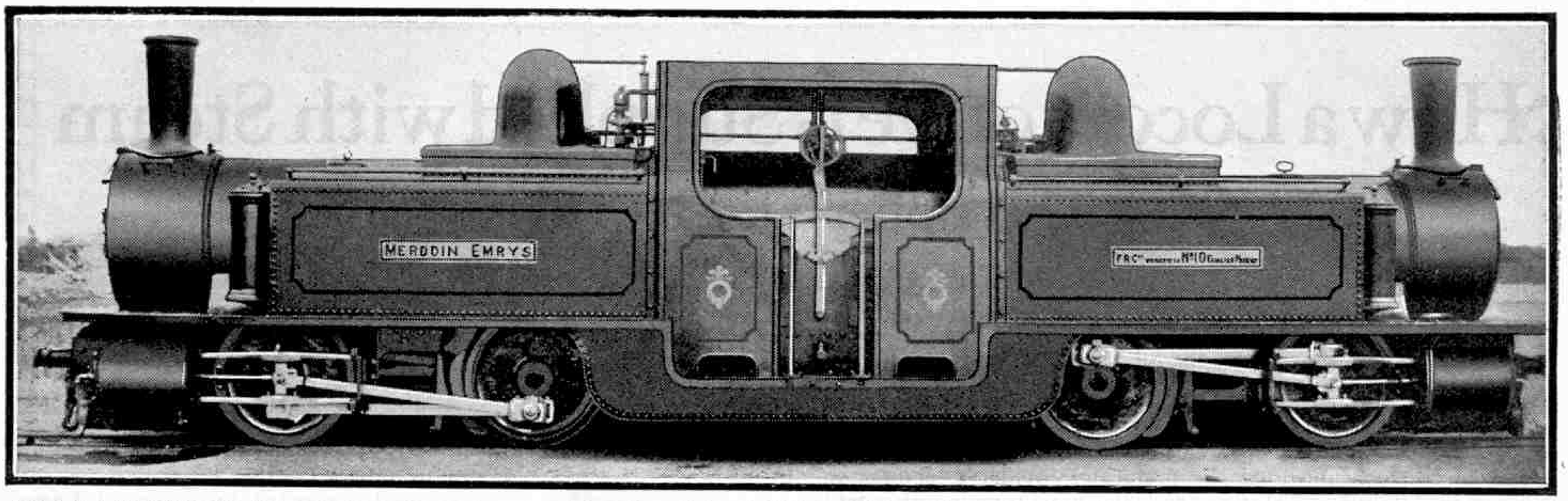
The G.W.R., in the endeavour to provide passengers with the most comfortable travel possible, have lately introduced a unique vehicle that indicates in a remarkable way any inequalities on the line which may make for unsteady running. This vehicle is known as the "Whitewash" coach. It is equipped with very sensitive mechanism which automatically records all defects in the track which may affect the running. When the "riding" of the coach is disturbed more than a predetermined amount, a specially-designed electrical apparatus opens a flap-valve, and about a quart of whitewash is deposited upon the track, thus marking the position at which the disturbance took place. This marking of the track draws the attention of the permanent-way ganger to the particular spots where some defects may need to be remedied.

The Cost of Luxury Travel

The L.N.E.R. have published some striking figures which show the costliness of modern luxury travel on such a train as *"The Flying Scotsman."* The cost of an engine of the "Pacific" type is £7,500 and the total cost of the train and engine is £42,500. The weight of the train when full of passengers is about 400 tons. It is made up of 220 tons of iron and steel, 120 tons of timber, 48 tons of brass, sundries, fuel and water, and 12 tons of passengers and luggage. Thus 97% represents the weight of the engine and carriages, and only 3% the weight of passengers and luggage. Taking a full complement of passengers as 360, it follows that more than one ton dead weight per passenger is hauled. The amount of coal required for the journey from London to Edinburgh is 4½ tons and 13,000 gallons of water are needed.

Oil-Electric Cars for British Railways

Many experiments are being carried out with a view to employing oil-electric propulsion in railway operation. The L.N.E. and Southern Railways are about to test this form of traction and two experimental rail-cars have been built by Messrs. Armstrong, Whitworth & Co., one for each of these lines. The cars, which are 60 ft. in length, are fitted with heavy-oil engines of the Armstrong-Sulzer type.



A 0–4–0 + 0-4-0 "Fairlie" type engine, used on a steep mountain railway in North Wales. This type of locomotive is particularly adapted to heavily graded lines abounding in very sharp curves.

Reconstructed "Claughtons" on L.M.S.R.

Locomotive No. 6158 of the "Royal Scot" class now carries the name "*The Loyal Regiment.*" No. 6109, "*Royal Engineer,*" has been fitted with smoke deflector sheets on the sides of the smoke-box.

The latest 4–4–0 express engines of "Class 2P" built at Crewe are Nos. 637-641. They are designated for work in the Scottish area.

The two reconstructed "Claughtons," or "Baby Scots" as they have been called, are doing well in service and fully justifying their drastic rebuilding. No. 5902, "*Sir Frank Ree,*" has been tried on various duties on the Western division. It was stationed for a while at Bushbury and worked on the fastest trains between London, Birmingham and Wolverhampton. Later it went to Liverpool (Edge Hill shed) and was employed on the "*Sunny South Express.*" More recently it has been stationed at Camden and used chiefly on Euston and Manchester expresses. No. 5971 has been stationed at Leeds and worked on the Midland division. It has been employed mostly between Leeds and Carlisle, but has also made numerous trips to London (St. Pancras) and back.

Southern Railway Locomotive News

Additional three-cylinder 2–6–0 engines of the "U1" class have been completed at Eastleigh works and are numbered 1902-4.

A large number of engines have already had their numbers altered in accordance with the new re-numbering scheme. Alterations have to be made not only to the numbers on the tender or tank sides but also on the front buffer beam and at the back of the tender or bunker, and two new metal number-plates have to be cast for each tender engine affected.

New G.W.R. Oiling System

At Swindon works the erection of five more 2–6–2 tank engines is being pushed forward. They will bear the numbers 6120 to 6124.

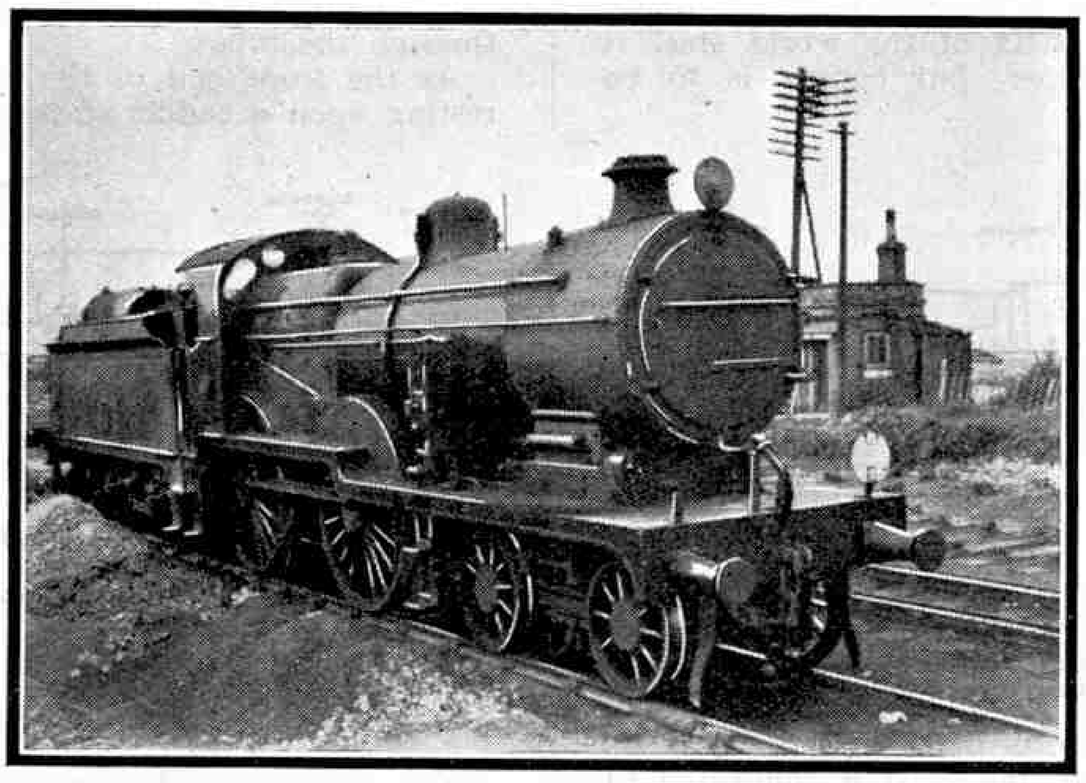
The new 0–6–0 tank engines to which reference was made in last month's "*M.M.*" will be numbered from 5400 upwards. Thirty are to be built in successive batches of ten. Work on the first batch has just been begun and they will not be completed until the end of this year.

A new series of engines of the handy "Mogul" class is about to be commenced. They will be generally similar in their dimensions to the engines of the "4300" and later series, but will have many improvements in detail, one of the most important being that they will have cabs of the "Castle" type. The first batch of these new engines will be numbered from 9300 to 9309.

A new method of lubrication has recently been applied to many G.W.R. locomotives, with excellent results. It is being used principally for the bearings of connecting and coupling rods, but is also being tested in the axle-boxes of a number of engines.

The new method dispenses with the strands of worsted, which usually are employed to syphon the oil from the cup or well through the oil-pipe on to the journal of the crank. Instead an oblong pad of felt is fitted at the base of the oil channel. This pad is kept saturated with oil, which it distributes over the surfaces that require to be lubricated. A second pad is fitted at the bottom of the bearing on the "big end" of the connecting rod of each inside cylinder on engines of the "King," "Castle" and "Star" classes.

The saving in oil which this new method effects is very considerable. An additional advantage is that the felt pad has a tendency to clean the bearing of grit that would tend to prevent smooth, cool running.



A Southern Railway 4–4–0 locomotive equipped for burning oil fuel during the coal strike of 1926. This engine is one of those designed by Mr. H. S. Wainwright and subsequently rebuilt and superheated by Mr. R. E. L. Maunsell with practically no increase of weight. This was necessary owing to the restrictions applying on the Kent Coast lines.

L.N.E.R. Tank Engines Rebuilt

Four of the three-cylinder 4–4–4 tank engines of the "D" class of the former North Eastern Railway have been rebuilt at Darlington and converted to the 4–6–2 wheel arrangement. The increased adhesion provided by the additional pair of coupled wheels should add materially to the usefulness of these engines, enabling them to start more rapidly and to mount gradients with less danger of slipping. The engines that have been thus rebuilt are Nos. 1499, 1517, 1326, and 2162 (formerly 2143).

The High-Pressure Locomotives

The L.N.E.R. high-pressure locomotive "No. 10000" worked for a week between Newcastle-on-Tyne and London during the summer season. It was booked to take the 10.15 a.m. ex Edinburgh (Waverley) from Newcastle to King's Cross (arriving at 6.30 p.m.) on Monday, Wednesday and Friday, and returned with the 10.5 a.m. (the "*Junior Scotsman*") on Tuesday, Thursday and Saturday.

The L.M.S.R. high-pressure locomotive "*Fury,*" which unfortunately burst a tube with serious results when making a trial run in February, 1930, has now been repaired and made ready for further trials.

The Fastest Train in the World

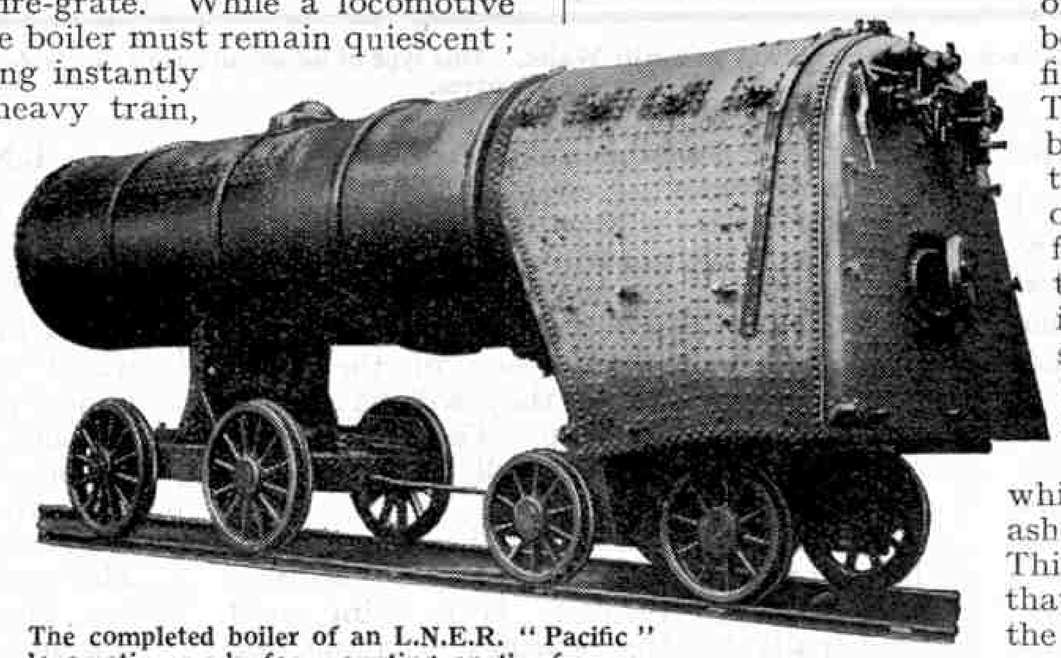
All railway enthusiasts will applaud the sporting enterprise of the Great Western Railway in again accelerating the famous "*Cheltenham Flyer*" and so making it once more the fastest train in the world.

As reported in the "*M.M.*" for August, the Canadian Pacific Railway, by booking the "*Royal York*" express to cover the 124 miles between Smith Falls and Montreal West in 108 mins. at an average speed of 68.9 m.p.h., wrested from the G.W.R. and from Great Britain the coveted record of possessing the world's fastest train. On Monday, 14th September, however, with the introduction of the winter train service, the timing of the "*Cheltenham Flyer*" between Swindon and Paddington was cut by three minutes, thus allowing only 67 mins. for the 77.3 miles and requiring an average speed, start to stop, of 69.2 m.p.h. On the first day of the new timing the train arrived 7½ minutes early at Paddington.

How a Locomotive is Supplied with Steam

The Boiler and its Parts

THE boiler is the most prominent feature of a locomotive, and at the same time it is one of the most important. An extraordinarily high efficiency is demanded of it. Not only must it supply sufficient steam to meet all requirements, but also it must be economical in working, that is to say it must provide for the greatest possible evaporation of water for each pound of fuel consumed on the fire-grate. While a locomotive in steam is standing in a station the boiler must remain quiescent; but it must be capable of supplying instantly the steam necessary to start a heavy train, and to keep the train moving at the speed required by the time-table. In addition to being able to develop enormous power, in some cases up to 2,000 h.p., the boiler must be of sufficient strength to withstand a pressure far in excess of that at which it normally works, and yet must not make the locomotive too heavy for the road upon which it is always to run. Finally the boiler must conform to the limits of the loading gauge of the line.



The completed boiler of an L.N.E.R. "Pacific" locomotive ready for mounting on the frames.

A locomotive fitted with a boiler that steams well is always reliable, and is capable of surprising feats in emergencies; while one with a poorly steaming boiler will be a constant source of worry to driver and fireman, and also to those who are responsible for the maintenance and repair of the engine.

A locomotive boiler may be considered to consist of four principal parts, the fire-box—inner and outer—the barrel, the smoke-box and the chimney.

In this country the inner fire-box is usually built of copper plates riveted together. In other parts of the world steel is frequently employed instead of copper, but copper is to be preferred on account of its high heat conductivity and its good wearing qualities. In all countries the outer fire-box is made of riveted steel plates.

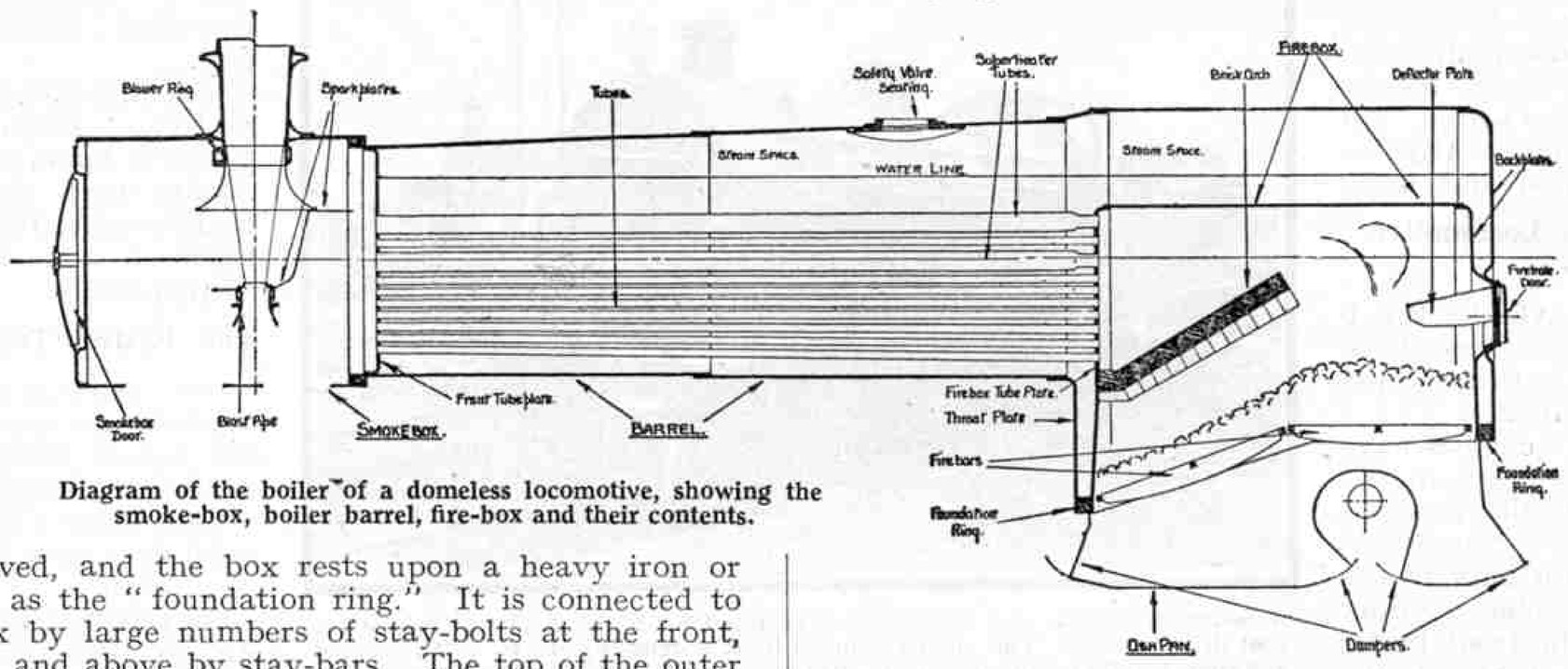


Diagram of the boiler of a domeless locomotive, showing the smoke-box, boiler barrel, fire-box and their contents.

The inner fire-box, although contained in the outer fire-box, is quite distinct from it. Its top is usually flat or very slightly curved, and the box rests upon a heavy iron or steel ring known as the "foundation ring." It is connected to the outer fire-box by large numbers of stay-bolts at the front, back, and sides; and above by stay-bars. The top of the outer fire-box may be semi-circular, or it may be flat as in the "Belpaire" type largely used in this country.

The barrel, which, as its name implies, is the long cylindrical part of the boiler, is constructed of plates rolled into circular rings. Mild steel is usually employed for this, although best quality iron was formerly much used. Recent researches have resulted in nickel alloy steel being employed to some extent in American practice. The back end of the barrel is secured to the upper portion of the front plate of the outer fire-box, known as the "throat-plate."

The front end of the barrel is closed by a circular plate riveted in position and called the "front tube plate." This plate separates the barrel from the smoke-box, and both it and the front plate of the inner fire-box are drilled to receive the ends of a large number of tubes that are inserted between them. The tubes are usually of steel, but brass, copper and iron are also used. Iron or steel tubes sometimes have brass or copper ends, brazed on at the fire-box end. These tubes, which may be 200 or 250 in number, are about 2 in. in diameter and each one is expanded in the plates in order to ensure a perfectly steam-tight joint.

At the bottom of the fire-box is situated the grate, consisting of iron bars resting lengthways in the box and supported by a sort of frame fixed across the bottom of the box. The bars of the grate are separated by spaces through which air is admitted to the fire to assist in the combustion of the fuel, special provision being made for the expansion of the bars when they become hot. As a rule a grate is not horizontal, the bars usually sloping upward towards the back so that the movement of the engine assists in working the fuel forward.

Beneath the grate is the ashpan, which forms a receptacle for retaining the ashes that fall from the grate above. This ashpan is fitted with hinged doors that act as dampers and are operated by the fireman from the engine footplate by means of a series of rods and levers. The ashpan, therefore, in addition to its primary function, affords a means of controlling the amount of air admitted to the grate from below.

The next important feature is what is known as the "brick arch," built of firebrick and situated above the grate. Its function is to assist uniform and thorough combustion of the gases arising from the fire by deflecting them around the fire-box. It also assists considerably in obtaining equal distribution of these gases through the tubes.

At the front end of the boiler is the cylindrical smoke-box, resting upon a saddle embedded in the cylinder castings. It is fitted with an air-tight door to facilitate the removal of ashes that have been drawn through the tubes by the draught. It also enables the tubes and superheater elements to be swept out, and makes possible the examination and repair of the forward portion of the boiler.

The chief contents of the smoke-box are the main steam-pipe, blast-pipe, blower, vacuum exhaust-pipe and spark arresters.

Through the blast-pipe, situated in the centre of the smoke-box below the chimney, passes the exhaust steam from the cylinders. The pressure at which it leaves the cylinders, added to the small diameter of the blast-pipe, causes the steam to attain a high velocity, and a partial vacuum is thus created in the smoke-box. Air then rushes into the fire-box through the fire-bars and dampers, and thus the necessary strong draught is induced.

The size of the opening of the blast-pipe is very important. An opening that is suitable for normal running may produce too fierce a blast when the locomotive is starting or ascending a steep gradient. As this excessive draught produces back pressure on the pistons, it is necessary to arrange some means of adjusting the blast-pipe outlet, according to the amount of work being performed by the engine.

Various mechanisms by means of which the driver could vary the size of the outlet have been tried, but although they are successful to a certain extent they easily get out of order. The smoke-box is not a suitable situation for devices of this kind, owing to the heat, and the liability of such apparatus to become choked with cinders and ash. This difficulty is rectified by the automatic "Jumper" blast-pipe, introduced on the G.W.R. by Mr. G. J. Churchward. This device is fitted with a ring which, when the engine is working heavily, is lifted by the pressure of the exhaust steam so that it provides an extra outlet to the extent of some 12½ sq. in., for the exhaust. When the pressure returns to normal the ring falls and the original state of affairs is restored.

Blowers are made in various forms, but in principle they all may be described as jets to blow up the fire when the engine is standing and the exhaust is therefore not available.

Spark arresters consist of iron plates or other contrivances placed above the tubes in such a position that they prevent ash and small particles of burning fuel from passing up the chimney and out into the open air. An extended smoke-box, which is often provided on modern locomotives, is always efficient in preventing the throwing of sparks.

One of the most familiar features above the boilers of the majority of locomotives is the steam dome, the object of which is to provide increased steam space above the water in the boiler. What is known as "dry" steam, that is steam that does not contain drops of water, is very much more effective as a working agent than "wet" steam. The dome provides a collecting space as far above the water as possible, and by taking steam for the cylinders from a regulator valve inside the dome, the risk of "wet" steam is greatly reduced.

Certain locomotives—of which those of the G.W.R. are a notable example—have no dome, but are provided instead with a greater steam space above the water level. This is effected by coning the boiler barrel in such a manner that the greatest diameter is reached just in front of the fire-box. Similarly the Belpaire fire-box is made to slope outward and upward from the cab, so that increased steam space is afforded exactly where steam generation is greatest.

All locomotives are fitted with thoroughly efficient safety valves, the most common type in this country being probably the "Ramsbottom" valve. Valves of this pattern are exceedingly simple, consisting essentially of two hollow columns, open to the boiler below and closed above by the valves, the latter being connected by a lever and held down by a spring. The strength of the spring is adjusted carefully so that the valves are lifted off their seats when the steam pressure reaches the amount for which the boiler is designed. Steam then escapes, and all danger of the boiler bursting is obviated. Usually the safety valves are placed over the fire-box, but in locomotives not having domes they are generally placed above the middle ring of the barrel. Modern practice favours the use of "Pop" safety valves, those of the Ross pattern being widely employed. Each valve is self-contained, and no lever is fitted. Valves of this type are very sensitive in action, and they allow a large volume of steam to escape quickly. They have also the advantage of requiring small head room, which is important in these days of large high-pitched boilers.

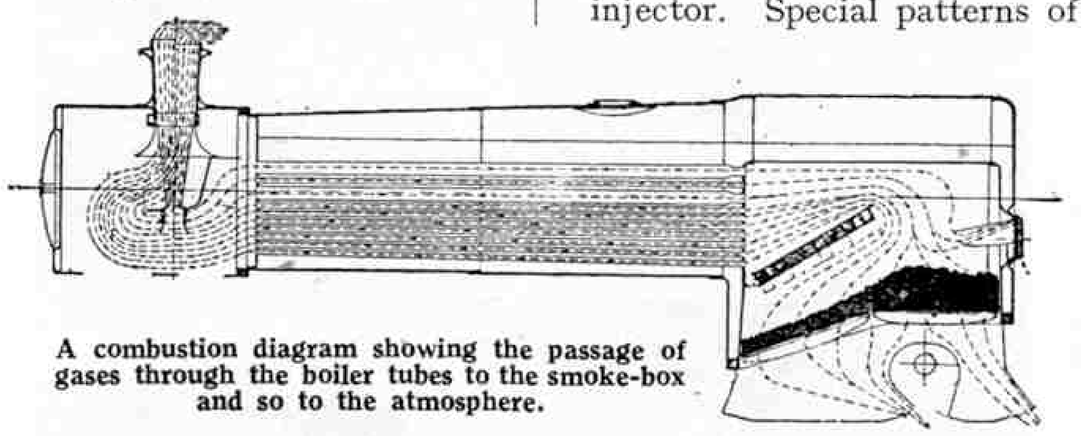
The chimney is situated above and supported by the smoke-box, and usually tapers slightly inward from top to base. The reverse of this practice was frequently seen years ago, the idea being that the smaller diameter at the top of the chimney allowed for the condensation of the steam as it passed upward, with a corresponding decrease in volume. Examples may still be observed on L.N.E.R. engines that belonged formerly to the Great Central Railway. The continuous increase in the size and height of boilers has resulted in a corresponding reduction in the height of chimneys, and steam domes also, in order to keep within the total limit of height 13 ft. 6 in. above the rail imposed by the British loading gauge.

The space between the inner and outer fire-box and also the inside of the barrel around the tubes is occupied by the water that is to be converted into steam. The whole furnace therefore is virtually surrounded by water. The reason for this arrangement, and for the large number of tubes, is to provide as large a heating area as possible in order that steam may be generated with sufficient rapidity to cope with all demands the engine may make upon the boiler.

Interior of a boiler barrel showing the fire-box, tube-plate and stays.

As the inner fire-box is made of copper, which melts at a comparatively low temperature, it is important that the "crown," as the top is called, should be kept covered with water to prevent the danger of its melting, which would result in serious damage to the engine. To avoid such danger a water gauge is fitted to indicate the level of the water in the boiler. In addition, lead plugs are fitted to the fire-box. These are in effect bolts having drilled through them a hole that is filled with lead. If the water level falls below the crown of the fire-box and thus uncovers a plug, the lead melts, water from the boiler comes through into the fire-box, and so extinguishes the fire. This does a certain amount of damage to the fire-box, but it is better than the alternative of having the fire-box melted away.

It is, of course, essential that means should be provided for feeding water into the boiler while in steam, thus maintaining the correct water level over the fire-box crown. Space will not allow more than a brief statement of the principles involved in the ingenious device known as the "injector," by means of which a regular supply of water may be forced into the boiler, notwithstanding the great pressure therein. The first injector was patented in 1858, but the appliance did not come into general use for some time after. Pumps were employed on the earliest locomotives and continued to be favoured by engineers for many years. Even now they are sometimes employed, especially where feed water heaters are used, as cold feed water is essential for the proper working of the ordinary injector. Special patterns of hot water injectors have, however, been devised, and are used to a certain extent.



A combustion diagram showing the passage of gases through the boiler tubes to the smoke-box and so to the atmosphere.

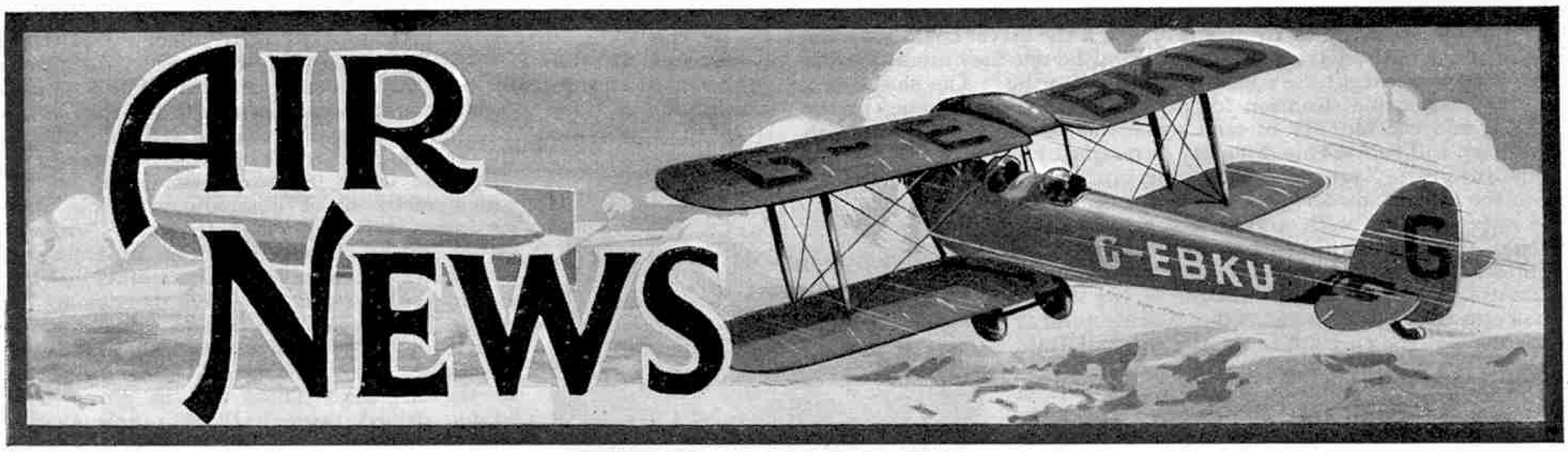
In an injector the velocity required to deliver the feed water against the boiler pressure is obtained by forcing the steam supply through a tapering nozzle or "cone" into a narrow water space. The steam is immediately condensed, but its velocity is sufficient to carry it, together with about twelve times its own weight of water, through a small tube and back check valve into the boiler, overcoming the pressure within. The vacuum induced by the condensation of the steam in live steam injectors is sufficient to lift the water from the supply tanks in the tender or elsewhere. As the temperature of the feed water rises, however, the distances that the water can be lifted is decreased.

View of an inner fire-box from underneath. The tube-plate is below, and the back-plate and fire-hole are seen above.

Considerable economies are realised by the employment of exhaust steam instead of boiler steam to work the injector. The exhaust steam for this purpose is led from a point at or near the base of the blast-pipe. As this steam comes from the cylinders, it naturally contains a certain amount of oily matter. In order to prevent this from entering the boiler, where its presence would be very injurious, a grease separator is used, through which the exhaust steam passes before entering the injector. These injectors are employed to a very large extent, as they make use of steam that otherwise would go to waste up the locomotive chimney. It is claimed that economies of from 10 to 15 per cent. in fuel, and 12 per cent. in water, are attained by this means.

Further economies result from heating the feed water before it is introduced into the boiler. Several patterns of feed-water heaters have been devised, but their use is not as yet standard practice in this country. Satisfactory results have attended the installation of a French system, known as the "A.C.F.I.," on a number of L.N.E.R. locomotives. This system was described in the "*M.M.*" for February 1930.

Other systems are experimentally employed to some extent in Britain and amongst these are the Worthington and the Weir. Many locomotive superintendents have devised systems and applied them to numerous locomotives of their design. The best known of these perhaps in recent times, was Mr. D. Drummond on the L.S.W.R. whose system was extensively applied on that line.



British Machine for Mail Carrying

Some time ago the Air Ministry published an official specification for a single-engined mail-carrying aeroplane, and invited members of the British aircraft industry to construct machines on the lines suggested. It is interesting to find that experimental work on a machine designed specially for fast mail carrying was undertaken by A. V. Roe & Co. Ltd. long before the Air Ministry's specification was published.

The Avro mailplane is of all metal construction and is fitted with an Armstrong Siddeley "Panther IIa" geared radial air-cooled engine developing 525 h.p. at 2,000 r.p.m. The machine has been made a biplane in order to keep the overall dimensions fairly low and to make repairs easier in the event of a forced landing in difficult country causing damage to a wing. Its overall span is only 36 ft., its length 30 ft. 10 in. and its height 10 ft. 6 in. When empty the weight is 3,077 lb. and when fully loaded this is increased to 5,150 lb. An unusual feature from the British point of view is the provision of a third wheel in place of the tail skid. All three wheels are provided with streamlined casings, and the two front ones are fitted with wheel brakes.

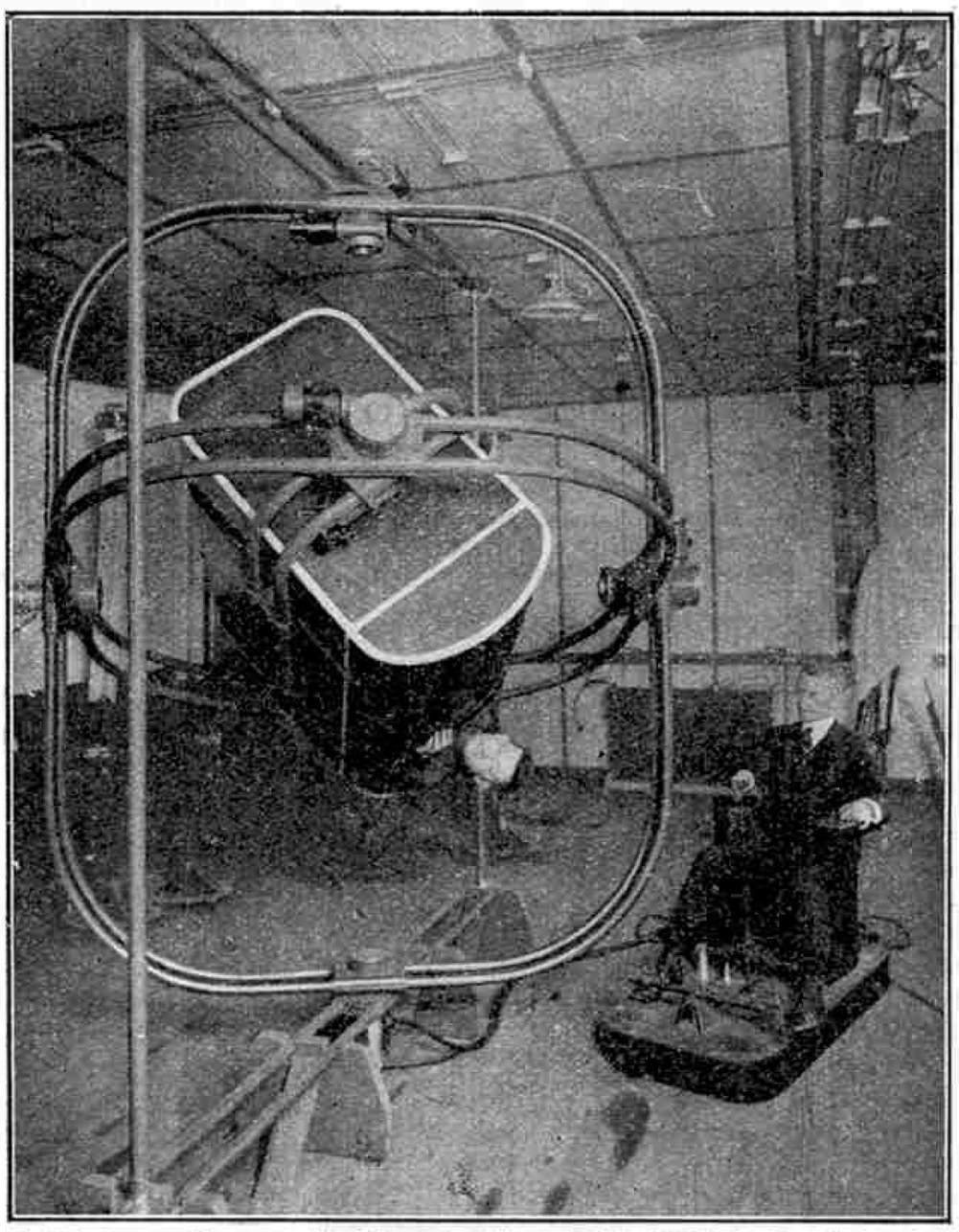
The machine is fast, and its maximum speed of 170 m.p.h. can be maintained at all altitudes up to 3,000 ft. Even at a height of 5,000 ft. its speed is only 2 m.p.h. less, and at an altitude of 10,000 ft. the decrease is 10 m.p.h. The landing speed is 66 m.p.h. and the cruising speed at a height of 3,000 ft. is 147 m.p.h. Sufficient petrol is carried to enable the machine to cover 560 miles at three-quarter normal power, but a distance of 600 miles may be covered by flying at a speed of 140 m.p.h. The initial rate of climb is 1,200 ft. per minute, and the machine will reach an altitude of 1,000 ft. in 0.83 minutes and one of 15,000 ft. in 23 minutes. The service and absolute ceilings are 17,500 ft. and 19,000 ft. respectively.

Sir Alan Cobham's Survey Flight

Sir Alan Cobham has made a flight over Central Africa in a Short "Valetta" seaplane, in order to survey an air route westward from the Great Lakes, and also to obtain information on the behaviour of the "Valetta" under African conditions. The flight was completed successfully.

Air Ensign for Great Britain

A Civil Ensign has now been designed for this country. It is a light blue flag carrying a dark blue cross edged with white and in the upper left-hand corner is a small Union. The Ensign may be flown by British aircraft registered in the United Kingdom and at all aerodromes situated in the United Kingdom that are fully licensed under the Air Navigation Act. Air transport companies owning licensed aeroplanes also may make use of it both on their aircraft and on any buildings they use for the purpose of air transport. The Ensign is to be recognised as the correct national flag to be flown by aeroplanes.



A device sometimes used to determine if a man is suitable for training as an air pilot. The beginner is seated in the cockpit of the strange box-like contraption, which is then whirled into various positions in imitation of the movements to be expected in actual flight.

An Australian Airman's Record

The longest one-day flight yet recorded in Australia was made a short time ago by Mr. H. F. Broadbent, who flew an Avro "Avian Sports" biplane, fitted with a de Havilland "Gipsy II" engine, a distance of 1,300 miles in 18 hours. This time included stops for breakfast and lunch.

Municipal Airport for Vancouver

The first unit of a new municipal airport at Vancouver, British Columbia, was officially opened a short time ago. The site occupies 469 acres at the mouth of the north arm of the Fraser River and provides ample space for future development. The main runway of the airport lies east and west, the direction of the prevailing winds. It is 2,350 ft. in length and 500 ft. in width, a central strip 100 ft. in width having a hard surface. The cross runway is 1,300 ft. in length and 500 ft. in width. In the complete airport the main runway will be 4,750 ft. in length and the cross runway 2,500 ft. Two others will be constructed at angles to the main runway, and these will be 2,200 ft. and 2,700 ft. in length respectively.

The seaplane port is in sheltered water at the mouth of the middle arm of the Fraser River, where a channel 1,300 ft. in length will be cleared. This will enable the machines to be taxied right up to the landing stage.

From Australia to England in 211 Hours

An outstanding recent flight was that of Mr. J. A. Mollison, who beat the record of 220 hours 11 minutes for the journey from Australia to England set up by Mr. C. W. A. Scott a few months ago. Mr. Mollison's flight was made in a D.H. "Gipsy Moth." He started from Port Darwin on 29th July, and arrived in England on 6th August, completing the journey in 8 days, 19 hours, 25 minutes, or 211 hours, 25 minutes.

The first stage of Mr. Mollison's journey was from Wyndham, Western Australia, to Batavia, Java, a distance of 1,730 miles. This is thought to be the longest day's flight that has ever been made in a light aeroplane. Mr. Mollison received a great ovation on arrival at Croydon at the conclusion of his wonderful journey.

Faster India Air Mail Service

A faster and more direct service between Britain and India is to be introduced this month by Imperial Airways. This has been made possible by the progress in construction of the port of Haifa on the coast of Palestine. The route will be the same as far as Athens, but after that Haifa will be reached via Cyprus whereas formerly the machines flew to Athens and Alexandria via Crete.

The Mark II Segrave "Meteor"

The upper illustration on this page shows a new model of the Segrave "Meteor" that has now been produced by the Blackburn Aeroplane and Motor Company Limited. The original machine constructed for the late Sir Henry Segrave was described and illustrated on page 221 of the "*M.M.*" for March, 1931.

The wing of the Mark II "Meteor" has no external bracing of any kind, and is constructed as one unit that can be removed from the fuselage or replaced as a whole without difficulty, thereby greatly facilitating repair. It is entirely of wooden construction and the covering is of plywood glued and bradded to the ribs, making an exceedingly strong and well-finished structure. The ailerons are of the normal type. The two engines are mounted on the wing, in which are the petrol and oil storage systems and also the ailerons controls, except for the actual operating levers. The central section forms the floor of the cabin.

The fuselage is constructed mainly of Alclad metal, which resists corrosion well. The cabin is a totally enclosed compartment arranged to carry four persons seated side by side in pairs, all facing forward. The starboard front seat is the first pilot's seat and dual flying controls are fitted on the port side. The seats are comfortably upholstered.

The cabin is designed to give accommodation as comfortable as that provided in a closed motor car. A remarkably wide field of vision is afforded to its occupants, the sides and roof consisting of thick non-inflammable transparent panels and the windscreens of safety glass with a sliding panel that can be opened to give an improved forward view when flying in bad weather. The framework of the cabin is built up of robust steel members with a central tubular pillar support, and the floor is actually the central section of the wing.

Accommodation for 70 lb. of luggage is available behind the rear seats and loading conditions will permit of the carriage of additional baggage on the floor of the cabin if desired. Locker space is provided below the rear seats.

The Blackburn "Meteor II" is fitted with two 120 h.p. de Havilland "Gipsy III" inverted engines. The machine has a span of 39 ft. 6 in., a length of 28 ft. 6 in. and a height of 7 ft. 9 in. It has a tare weight of 2,075 lb., and a fully-loaded weight of 3,300 lb.

The top speed of the machine at sea level is 142 m.p.h., while it lands at 55 m.p.h. and cruises at 120 m.p.h. The initial rate of climb from sea level is 900 ft. per minute, and the service ceiling is 16,500 ft. When fitted with normal tankage 42 gallons of petrol may be carried, giving a range of 420 miles. The maximum petrol capacity is 52 gallons, and thus a flight of 520 miles may be made without refuelling.

A side view of the metal Blackburn-Segrave "Meteor" described on this page. For permission to publish the photograph we are indebted to the courtesy of the Blackburn Aeroplane and Motor Co. Ltd.

Safer Fuel for Aircraft

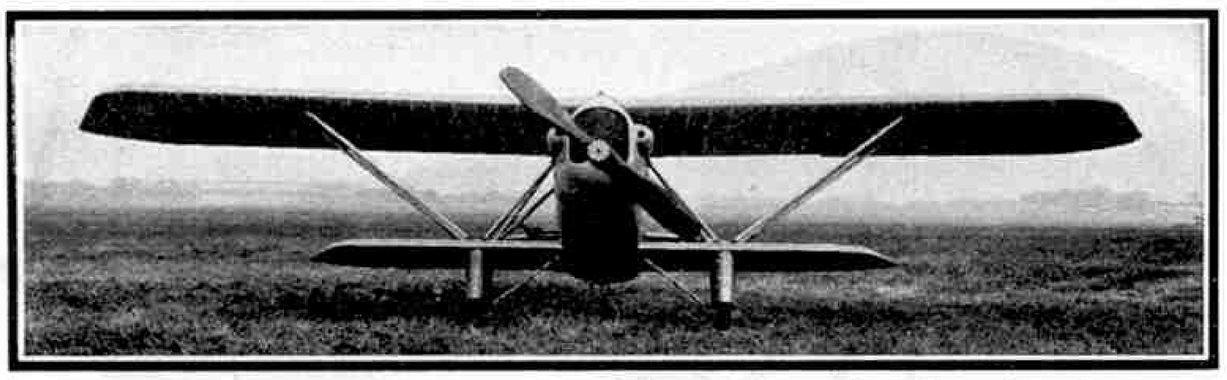
One of the greatest disadvantages of the internal combustion engines used on aeroplanes is the liability of the petrol supply to catch fire in the event of a crash. Danger from this source should be abolished by the adoption of a new fuel that has been invented by General Ferrie, Chief of the Radio Telegraph Services of the French Army, for this is not inflammable when its temperature is below 98°F.

The new fuel possesses other important advantages. The chief of these is that it is lighter than petrol and its use gives an extended range to aeroplanes in which it is used. In addition it leaves little carbon deposit in the engine and its corrosive effect upon the material employed in the construction of tanks and piping is negligible. It can be produced at a net cost of five-sevenths of the price of ordinary aviation spirit.

Experiments with the new fuel proved so successful that it has been given a trial by the Air Union, the French company that operates on the London-Paris service. It has now been used in the machines operated by the Air Union for several months, and the results are said to be satisfactory.

Elevated Aerodrome for Paris

Last month reference was made to a scheme for the construction of an elevated aerodrome over King's Cross and St. Pancras goods stations in London. A similar scheme has now been suggested for Paris, where the suggestion has been made that a similar aerodrome should be built over the Parade Ground at Issy le Moulineaux, which is near the Porte de Versailles. The proposed airport would be constructed on top of a building several storeys in height that would provide space for warehouses and offices in addition to accommodation for machines. The area of the landing ground would be about 140 acres and as the suggested site is near the river a port for seaplanes also could be constructed.



A Descamps 17 A.2 reconnaissance machine. This aeroplane, which is used by the French Air Force, is of the all metal type.

World's Records for Poland

Two international air records have been secured by Polish aviators flying in machines designed and built in Poland. These are the speed and altitude records for light aeroplanes not exceeding 617 lb. in empty weight. The first of these was set up by M. Jerzy Drzewiecki, who flew an R.W.D. 7 two-seater monoplane, fitted with a British Armstrong Siddeley "Genet" engine, at a speed of 111.8 m.p.h. over a circuit of 100 km. The altitude record of 19,487 ft. also was set up in an R.W.D. machine, the pilot being Lieut. Zwirko. The altitude reached was nearly 2,100 ft. more than the previous record, which was held by France with a Farman 230 monoplane.

Three R.W.D. aeroplanes took part in the International Tour of Europe last year. The machine is a high wing monoplane. Its cabin structure tapers upward to a narrow top, and pilot and passenger look out through port-holes in its sides, no direct view ahead being obtainable. For this reason the three machines were nicknamed "*The Three Blind Mice.*"

New de Havilland Light Aeroplane

The de Havilland Aircraft Co. Ltd. have constructed a new light aeroplane. This is known as the D.H.81, or the "Swallow Moth," and is a low wing monoplane. The machine has been constructed for experimental purposes. It will be followed by other experimental aeroplanes, and eventually it is hoped to make use of information obtained from their trials in designing a new standard type.

The "Swallow Moth" is equipped with an 88 h.p. inverted engine of a new type that will be known as the "Gipsy IV" when it is put into regular production. Further details of the experimental machines and of the "Gipsy IV" engine will be included in the pages of the "*M.M.*" as soon as they are available.

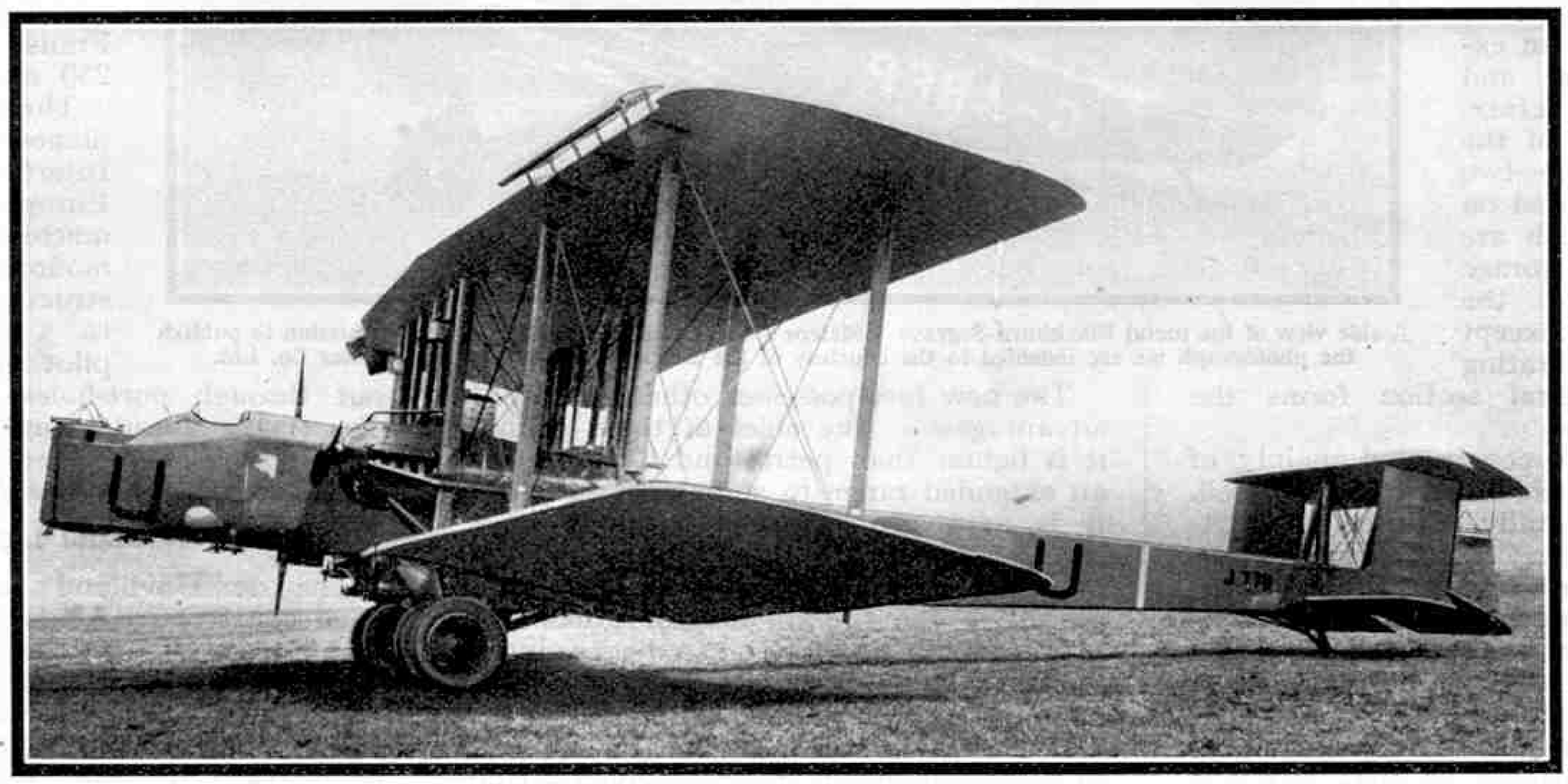
New German Zeppelin

On page 131 of the "*M.M.*" for February 1931 we reported that work on the new German airship "L.Z.128," had been stopped in order to redesign and modify it to make it suitable for use with helium instead of hydrogen as the lifting gas. It has been found that this reconstruction would be impracticable and an entirely new ship therefore is to be built. This vessel is to be called the "L.Z.129" and will be equipped with four heavy oil engines, each of which will develop between 850 h.p. and 950 h.p. Accommodation for 50 passengers will be provided and, as in the case of the British airship "*R.100*," the passenger quarters will be inside the hull. The vessel will be 810 ft. in length, and her greatest diameter 132 ft., while her total capacity will be 7,000,000 c. ft. The capacity of the "*Graf Zeppelin*" is 3,500,000 c. ft., while that of the projected "L.Z.128" was to have been 5,500,000 c. ft.

Modern Bombing Aeroplanes

Machines Designed to Raid Enemy Aerodromes

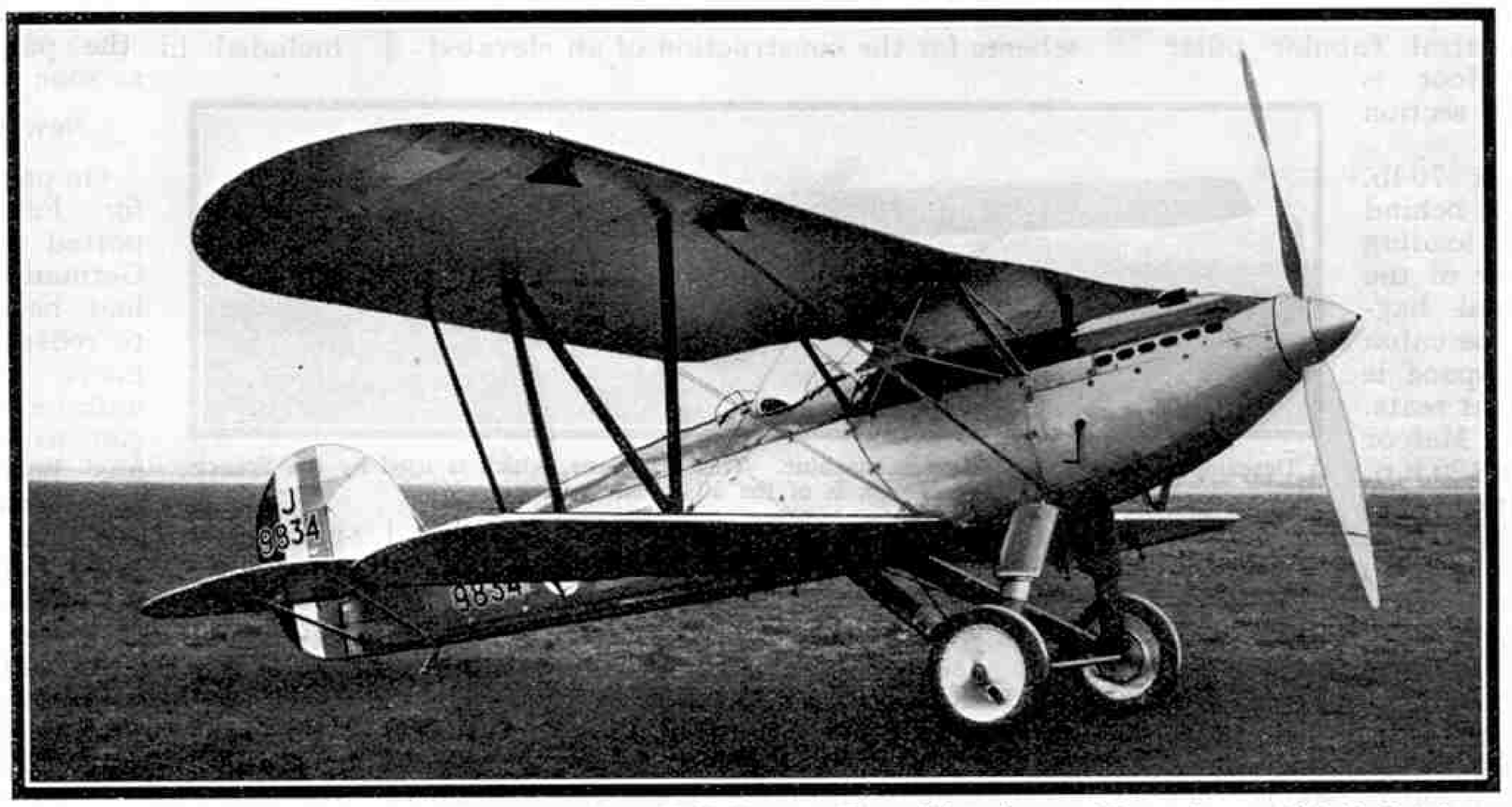
WHEN the aeroplane was being slowly developed from the crude machines in which the Wrights and other pioneers first flew, it was realised that aircraft would be extremely useful in war, and many of the writers on the subject immediately pointed out that they could be employed for bombing positions behind enemy lines. It is scarcely surprising to find, therefore, that efforts to carry out bombing raids were made within a few weeks of the commencement of the Great War. The first bombing raid appears to have been carried out on 24th August, 1914, when an R.F.C. machine engaged on reconnaissance work dropped a bomb on a German aerodrome. In the following month four aeroplanes of the Royal Naval Air Service left Antwerp to bomb Cologne and Düsseldorf. Only one of the machines reached its objective, and it failed to inflict any damage. What may be described as the first successful air raid was made in November, 1914, when bombs dropped from a Royal Naval Air Service machine piloted by Flt. Lt. Marix completely destroyed a Zeppelin then housed in a shed at Düsseldorf.



The latest model of the Vickers "Virginia" night bomber. For permission to publish this illustration and the upper one on the opposite page, we are indebted to Vickers (Aviation) Ltd.

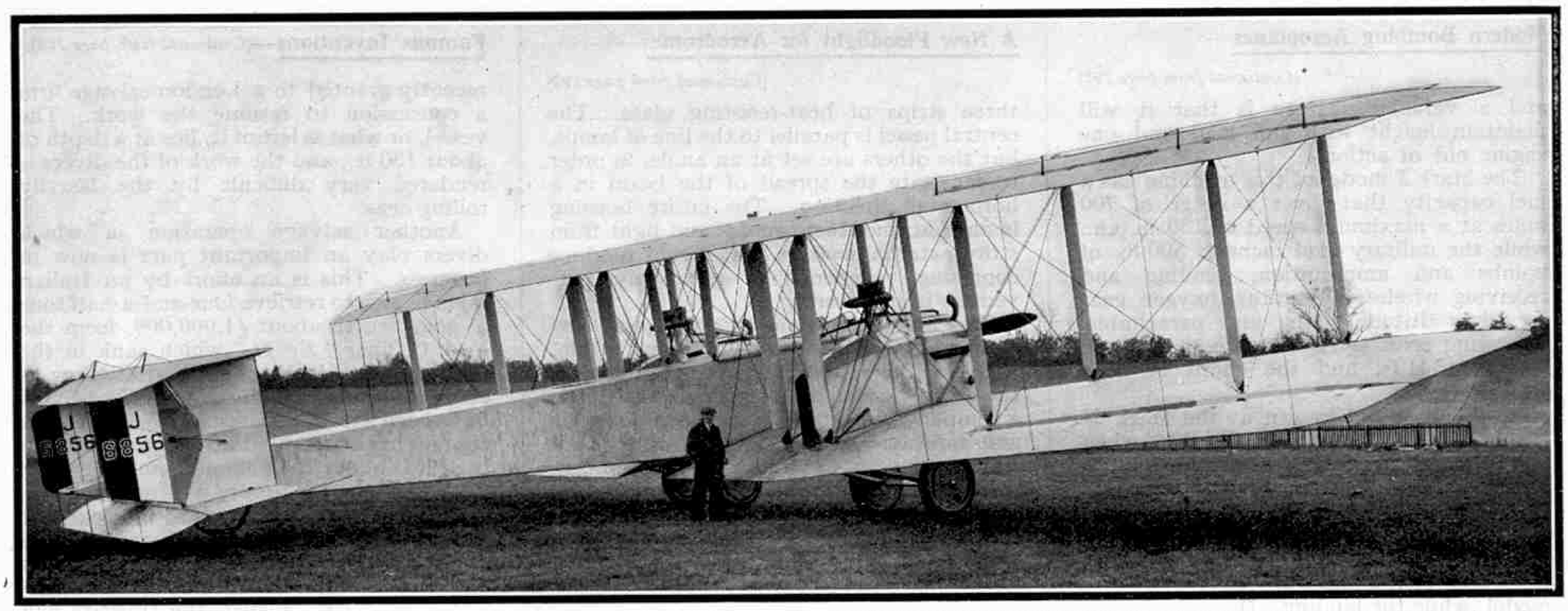
Since then the practice of dropping bombs from aeroplanes upon selected targets has been extensively developed. The principle adopted is that attack is the best form of defence, for thus an enemy may be prevented from developing his own attack on efficient lines. Clearly it is better to destroy enemy aeroplanes on their own aerodromes by means of bombs than to rely upon such purely defensive means as shooting them down when they attempt raiding operations. A further advantage of taking the offensive is that an enemy could quickly be crippled by the destruction of his aircraft works and munition factories, and merely to damage these would seriously hamper the necessary work of replacing losses in actual fighting.

It is interesting to note how bombing methods have changed as the aircraft employed have been improved. A load of bombs is a heavy addition to the equipment of a machine, and the aeroplanes used for this work in the Great War, particularly in its early stages, were slow and not easily defended when attacked by enemy airmen. Bombing therefore was usually carried out at night. Since then it has been realised that faster machines were required and that particularly for daylight work bombing machines of the highest speed would be necessary. Rapid developments now have been made in both directions, and special machines have been designed for use in the daytime. The types may easily be distinguished, the machines employed for day work being the smaller of the two. They are usually equipped with a single engine, and carry a load of about 500 lb. of bombs. Night bombers are huge machines that invariably employ two engines and are capable of carrying a much greater load of bombs than the aeroplanes used in daylight. They are not readily seen against the dark sky, for they are painted in dark colours and therefore are difficult targets for anti-aircraft guns.



The Fairey "Fox II" day bomber equipped with a Rolls-Royce "Kestrel" engine. The racks on which the bombs are carried may be seen under the wings. Photograph by courtesy of the Fairey Aviation Co. Ltd.

The two types of bombers employ different tactics. Day bombers are high speed machines and usually work in formation. When a squadrom takes off to carry out work allotted to it, it does not deviate from its course except under very unusual conditions. For instance, if enemy aircraft are seen making for vulnerable points, the bombers leave them alone and continue with their own appointed task. Even when attacked by fighting machines, they trust to their high speed and to the efficiency of the machine gunners in their rear cockpits for protection and endeavour to carry on with their work. The employment of flight formations also helps greatly in preventing interference with their progress, and a machine that for any reason breaks away has little chance of getting home safely.



An early model of the Vickers "Virginia" bombing machine. A comparison of this photograph with that of the latest type "Virginia" on the previous page will show how the design of the machine has been altered.

Night-bombing machines usually work singly. There are many advantages in this practice, the most important being that a single machine is less easily found by enemy searchlights than a squadron would be. In addition, there would be little advantage, from a defensive point of view, in formation flying, and in darkness this also would be dangerous, for there would be great risk of collision.

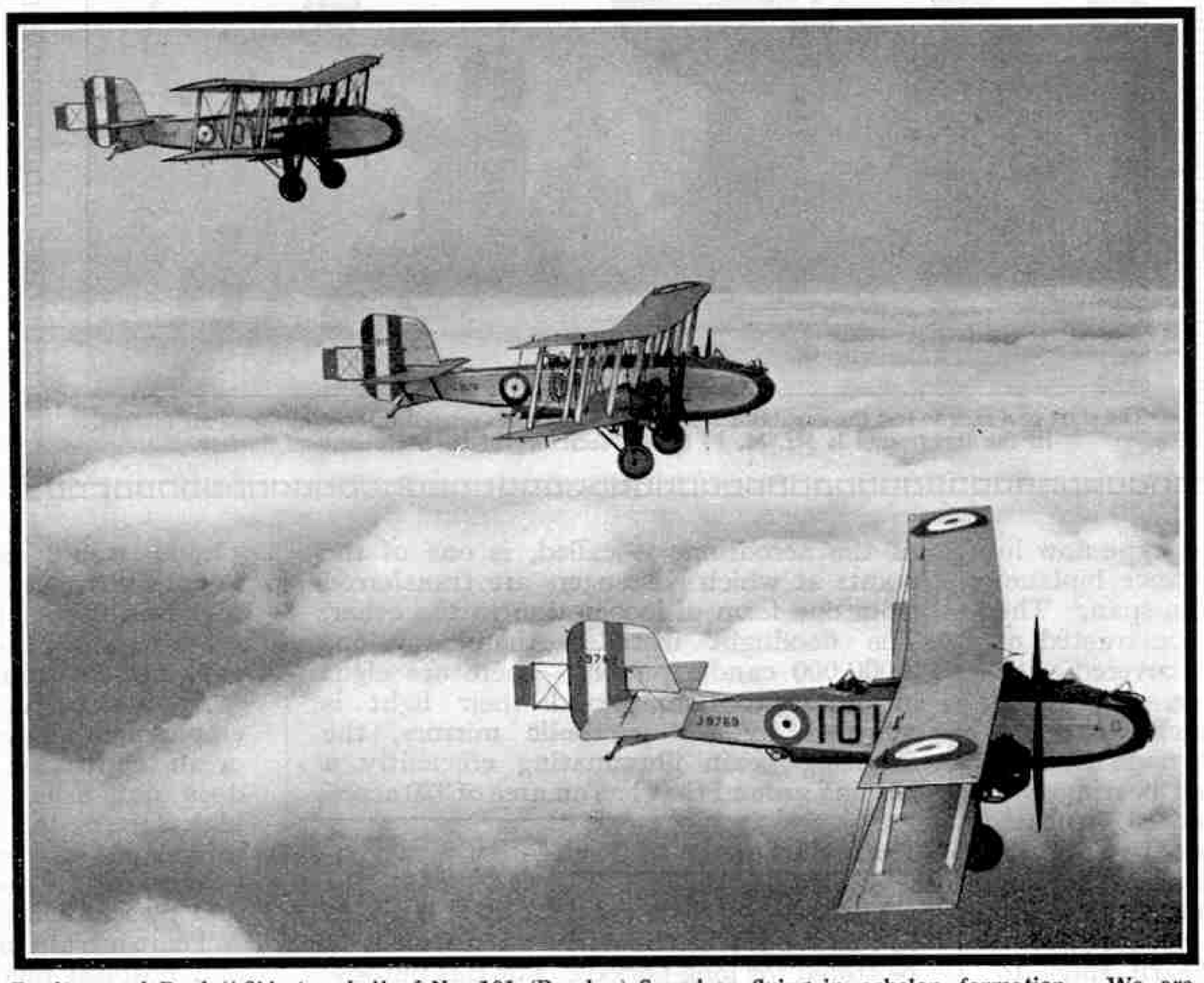
As night bombers operate singly and are not protected from attack by the presence of other machines flying in formation, they are fitted with several gun cockpits. These are so placed that the machine has no "blind spots" or positions from which an enemy airman could shoot into the bomber while himself remaining out of reach of his opponents' guns. The tail of a machine is a particularly vulnerable point and one of the gunner's cockpits is usually placed there.

It is interesting to note that the present trend of design is in favour of the construction of small machines possessing very high speed and carrying only a small load of bombs.

Bombing attacks may be carried out either at high or low altitudes. Raiders flying low cannot be seen from their objective until they are very near and little time is left for enemy fighting squadrons to be sent up in order to attack them. Even when these squadrons do take off, they work at a disadvantage, for the machines composing them are very fast and require a considerable amount of space in which to work. Low flying has the disadvantage that if the engine fails, or is put out of action by enemy fire, a crash is almost inevitable, however, and in that case there would not usually be time in which to get rid of the dangerous load of bombs before striking the ground. On the other hand, in high flying attacks it is often possible to glide back into friendly territory when the engine fails, and in any case the bombs may be dropped and a safe landing made. These advantages outweigh those of low flying, and modern bombing attacks are therefore carried out at fairly high altitudes.

The bombs carried by the raiding machines are mounted on racks under the wings and are dropped by means of special releases. They are sighted by the gunner, who usually lies prone over an opening in the floor of the fuselage. The bomb releases have until recently consisted of special lever devices, but a new gear has been introduced that is claimed to work more quickly and gives increased accuracy. Details of the working of this device are kept secret by the Air Ministry.

The world's fastest day bomber undoubtedly is the Hawker "Hart." This two-seater machine is fitted with a Rolls-Royce "Kestrel" engine, and although the machine is capable of 180 m.p.h. it can fly at the remarkably low speed of 55 m.p.h. without being in danger of stalling. Its all-round performance is superior to that of any single-seater fighter machine at present in production. The "Hart" was chosen by the Air Ministry for re-equipping a number of bomber squadrons of the R.A.F.



Boulton and Paul "Sidestrands" of No. 101 (Bomber) Squadron flying in echelon formation. We are indebted to the courtesy of the Editor of "Flight" for this photograph.

Other day bombers at present used by the regular squadrons of the R.A.F. are the Boulton & Paul "Sidestrand," the Hawker "Horsley" and the Fairey "Fox" and Fairey "111F." Four overseas squadrons also are equipped with Fairey "111F's," while six employ Westland "Wapitis" and two make use of Vickers "Victorias." An illustrated description of the "Victoria" was published on page 716 of last month's issue of the *"M.M."*

Of the day bombers previously mentioned the most unusual undoubtedly is the Boulton & Paul "Sidestrand," for this is the only twin-engined day bomber employed in the R.A.F. The use of twin engines on the machine is thought to give a more stable platform for the gunners, while the increased power makes it possible for a bigger load to be carried. The machine has three gun positions that between them leave no "blind spots." It is used by No. 101 (Bomber) Squadron, which is stationed at Andover, Hants.

The "Sidestrand" is a three-seater medium range day bomber and is equipped with two Bristol "Jupiter VIII" engines developing 460 h.p. at sea level. It is an equal wing biplane and is slightly staggered, which means that the leading edge of the upper wing is in front of that of the lower wing. The engines are carried in nacelles mounted on the lower wings and the sections of the wings outside the engines have a small "sweep-back" or, in other words, a slant toward the tail. The "Sidestrand" is light on the controls for a twin-engined machine of its size,

(Continued on page 798)

Modern Bombing Aeroplanes—

*(Continued from page 797)

and a valuable feature is that it will maintain height with full load and one engine out of action.

The Mark I model of this machine has a fuel capacity that gives a range of 700 miles at a maximum speed of 130 m.p.h., while the military load includes 500 lb. of bombs and ammunition, sending and receiving wireless apparatus, oxygen gear for high altitude flying and parachutes. The wing span is 72 ft. while the overall length is 41 ft. and the chord of both wings 7 ft.

A second model known as the Mark II "Sidestrand" weighs 6,010 lb. when empty, ahd its total loaded weight is 10,200 lb. Its maximum speed at an altitude of 10,000 ft. is 140 m.p.h., 10 m.p.h. more than that of the Mark I model, while the landing speed is only 54 m.p.h. The new machine occupies 19 minutes in gaining an altitude of 15,000 ft., and the service ceiling is 24,000 ft. A distance of little more than 100 yds. is needed for the machine to take off.

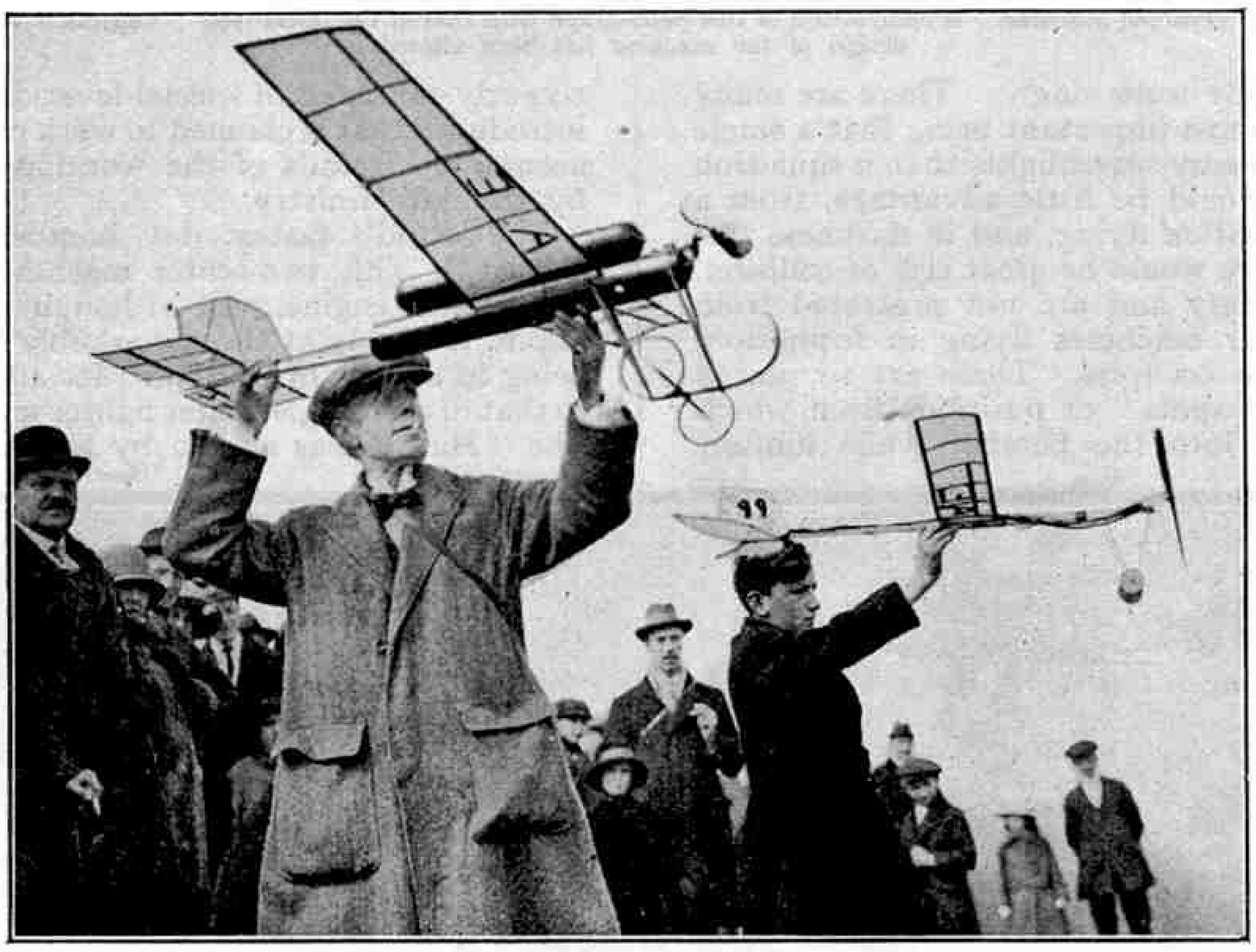
There are only five regular night bombing squadrons in this country, and three of these employ Vickers "Virginia" machines, the others being equipped with Handley Page "Hyderabads" and "Hinaidis." All these night bombers are fitted with Napier "Lion" engines except the "Hinaidi," which makes use of Bristol "Jupiter VIII" engines.

The most modern night bomber used by the R.A.F. is the Vickers "Virginia," a machine that in various forms has been in service in the R.A.F. for many years. The type now in use is a four-seater long distance biplane, the wings of which are equal in span. The fuselage of the machine is constructed of metal. The front section is covered with plywood, and the remainder with fabric except for the tail cockpit which is panelled with plywood. The undercarriage consists of two independent units each bearing two wheels. The units are situated beneath the engines and each consists of two normal type Vees with a front shock absorber leg of the Vickers Oleo-pneumatic type.

The machine has three cockpits, two of which are fitted with Scarff rings to carry machine guns and enable them to be swivelled round and brought to bear upon enemy machines without effort. One of these is in the nose and the other is behind the tail unit. The machine is capable of carrying a total weight of approximately 3,000 lb. of bombs, and the racks are arranged to accommodate bombs of various weights, from those weighing 112 lb. to giants weighing as much as 520 lb. or 550 lb.

The span of the "Virginia" is 87 ft. 8 in. and the chord 13 ft., the length being 62 ft. 3 in. The machine weighs 9,650 lb. when empty and 17,600 lb. when fully loaded.

MODEL AEROPLANE RACING



The start of a race to test the capabilities of model aeroplanes propelled by compressed air motors. In the foreground is Mr. M. P. Green, secretary of the Aeronautical Society.

A New Floodlight for Aerodromes—

(Continued from page 799)

three strips of heat-resisting glass. The central panel is parallel to the line of lamps, but the others are set at an angle, in order to facilitate the spread of the beam in a horizontal direction. The entire housing is airtight and dust-proof; and light from stray external sources that would produce confusing reflections is effectively prevented from entering.

The first aerodrome to adopt the new floodlight was that at Columbus, Ohio, U.S.A. This is the eastern air terminal of the Trans-Continental Air Transport Lines, a company that has organised combined air and railway journeys between New York and Los Angeles, California. Port Columbus, as the aerodrome is called, is one of the points at which passengers are transferred from one form of locomotion to the other. The floodlight installed there develops 3,000,000 candle power. There are eight incandescent lamps, and their light is reflected by six parabolic mirrors, the resulting beam illuminating efficiently a landing ground that has an area of 320 acres.

The Cold Storage of Fruit—

(Continued from page 781)

to remove it; particularly when fruit is to be stored for long periods. For this purpose a fan is provided for drawing off the carbon dioxide, and discharging it outside through a suction duct fitted at the floor level of the cold rooms.

In order to facilitate continuous observation of the temperature and humidity in the cold rooms remote thermometers and hygrometers are provided. They are installed in such a manner that the conditions of each individual room can be controlled from the machine room.

The steam required for the fruit-drying is raised in a Sulzer Cornish boiler with a heating surface of about 370 sq. ft. working at a maximum pressure of 85 lb. per sq. in.

Famous Inventions—

(Continued from page 773)

recently granted to a London salvage firm a concession to resume the work. The vessel, or what is left of it, lies at a depth of about 130 ft., and the work of the divers is rendered very difficult by the heavily rolling seas.

Another salvage operation in which divers play an important part is now in progress. This is an effort by an Italian salvage firm to retrieve four-and-a-half tons of gold, worth about £1,000,000, from the P. & O. liner "*Egypt*," which sank in the Bay of Biscay in May, 1922, after being in collision with a French steamer. The divers have been at work for several years. Depth charges have been used to cut a way through the decks above the bullion room, and at the time of writing a start has been made to clear out the debris that has fallen into the cavity. When this job has been completed, the treasure will be revealed, and the divers will then remove it, either by lifting the treasure chamber or by cutting a hole in the roof so that they can withdraw the ingots by means of a grab. Continual rough seas and strong gales have made the work difficult, but it is now confidently expected that it will be brought to a successful conclusion.

What Shall I Be?—

(Continued from page 775)

of course. This may be from £500 to £5,000, or even more, the amount depending on such factors as the turnover, the nature of the business transacted and the value of the stock taken over. For starting a new business it has been estimated that from £500 to £1,500 would be required, determining factors in this case being the value of the premises taken, the character of the surroundings and the fact that a new business may not be profitable in its early years.

An alternative to retail shop work is employment as a dispenser in a hospital or an institution. A position of this kind does not usually carry with it a very high salary, but for those who are more interested in the dispensing side of the profession it may provide a congenial and pleasant career.

There are also openings in manufacturing and hospital pharmacy, and in analytical and general chemistry, and the aim of the Pharmaceutical Chemist, with his greater scientific knowledge will probably be to enter one of these branches, for they offer more scope for utilising it. For those who wish to engage in work of this kind a degree in chemistry or in pharmacy is a great advantage and, in fact, practically essential. In particular those who hope to take up the subject of the analysis of food and drugs—a very suitable one for pharmacists with definitely scientific inclinations—must secure Fellowship of the Institute of Chemistry in the branch that is concerned with this work.

A New Floodlight for Aerodromes

Illuminated Landing Grounds for Pilots

DURING recent years there has been a great increase in the amount of night flying, particularly in the United States, where mails are now regularly carried over long distances at night by aeroplanes. This increase has made necessary the development of effective methods of lighting both air routes and aerodromes in order to assist pilots and ensure the maximum safety in night operations. Night air routes are usually marked out by means of beacons employing neon lamps, and various forms of these land lighthouses have been described in the "*M.M.*" Their orange rays penetrate fog better than white light, and with their aid pilots readily find their way except in conditions of the worst visibility.

The efficient lighting of aerodromes is not so easily carried out as that of air routes, for it is necessary to illuminate the entire surface over which aeroplanes run when starting a flight, or on landing. Ordinary searchlights and floodlight projectors are not efficient for this purpose, for their beams usually do not spread out at a sufficiently large angle, and unless they are carefully handled they may dazzle and hamper the pilots they are intended to help. For this reason an entirely new type of aerodrome floodlight has been developed by the General Electric Company of New York. It contains a number of high-powered incandescent electric lamps arranged in a row in front of vertical parabolic mirrors that send out a flat beam of light. This beam spreads out over the surface of the aerodrome, but does not rise high enough to interfere with the vision of pilots, even when they are running directly into the beam itself.

As shown in the above photograph, the aerodrome floodlight described in this article gives a flat beam of light that illuminates the ground, but does not rise more than 6 ft. or 8 ft. above it. This illustration is reproduced by courtesy of the General Electric Company of New York.

The new floodlight is not intended to be portable in the ordinary sense, but it is mounted on a pair of easily removable wheels, in order that its position may be changed quickly when necessary. Little difficulty, therefore, is experienced in making the best possible use of it in all circumstances. Its rays are so powerful that a newspaper may be read by means of them at a distance of a mile from the floodlight; and pilots, when landing, can readily detect irregularities of the ground at any point within a distance of 2,500 ft. from its position. The lamps used, which have been specially designed for the purpose, are gas filled and are made tubular in shape in order that the heat developed may be radiated away rapidly. The normal floodlight unit contains 14 lamps.

It is important that a source of light that is to be reflected from a parabolic mirror should be as small as possible. In the ideal unit it would be concentrated at the focus of the reflector, for then the whole of the light that struck the mirror would be radiated in a narrow beam instead of straying upward or downward. In practice this cannot be done, but in the new floodlight the thick tungsten filaments of the lamps are coiled tightly together so as to give a small but intense spot of light. In addition, the bulbs and the fittings in which they are held are made with the utmost accuracy in order that, when the unit is assembled, the filaments may fall automatically into the correct position.

The 14-lamp unit contains six mirrors made of special optical glass, and carefully ground to shape. They are parabolic in the vertical direction only, so that horizontal rays from the lamps are able to spread out over the surface of the aerodrome and all others are reflected at practically the same level.

Normally the top of the beam is not more than 6 ft. or 8 ft. above the ground, but by tilting the mirrors slightly its position may be altered to suit the special conditions at any aerodrome. Six openings in the rear of the floodlight housing allow access to the mirrors in order that any desired change may be made. It is thus easy to keep the light below the line of vision of pilots, while the field is amply illuminated, the floodlight spreading horizontally outward over an angle of 160 deg., although its vertical divergence is only 3 deg. in extent. The lamps are provided with shades that prevent direct light from escaping upward at the front, and two larger shades at the sides cut off light rays that do not form part of the beam.

The backs of the mirrors employed have heavily coated reflecting surfaces. Each mirror is 3 ft. in height and 15 in. in width, and together with the lamps they are mounted on a rigid welded pipe structure. This is completely independent of the framework that contains the unit, and therefore vibrations of the housing do not affect the beam of light.

The housing of the floodlight itself is of fabricated steel. It is about 8 ft. in height, 10 ft. in width and 4 ft. in depth, and is designed so that convection currents carry the heat from the incandescent lamps to the metal housing, where it is readily dissipated. The unit is normally orange in colour, and on the top it has a black diamond-shaped mark that enables pilots to recognise it in the daytime as an obstruction on the outskirts of the aerodrome that it illuminates.

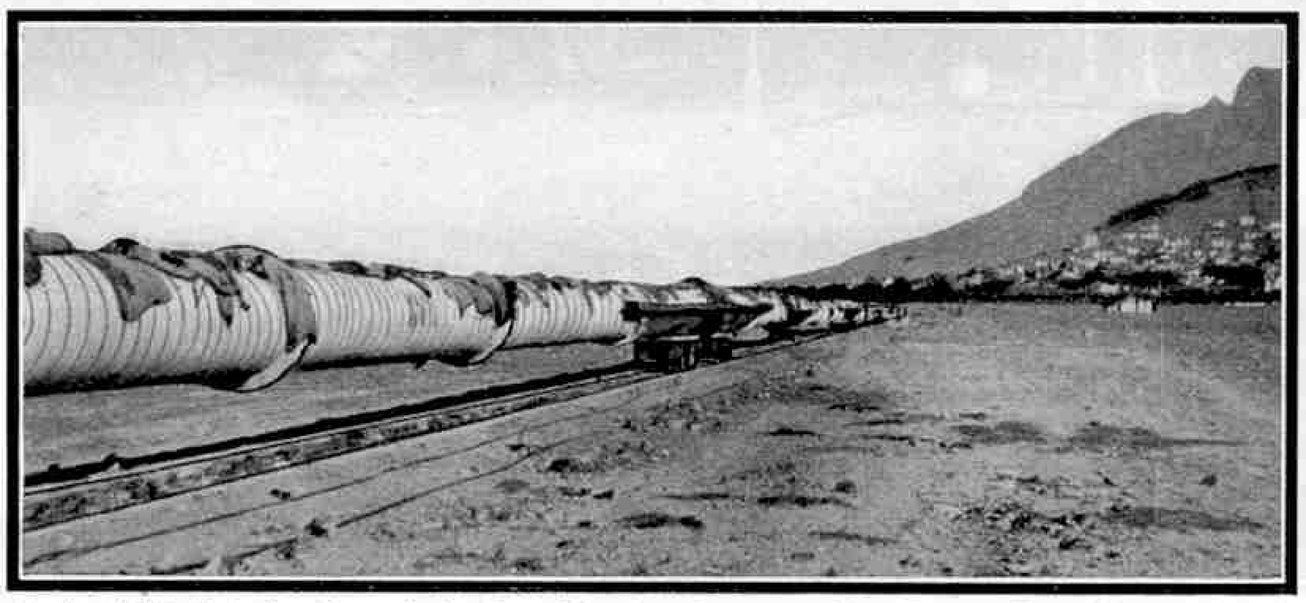
The lamps and mirrors are enclosed in a housing consisting of three rectangular panels each containing (*Continued on page 798*)

FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

Launching a Sewage Pipe

At Cape Town a steel sewage pipe 1,880 ft. in length was recently carried out to sea by the remarkable process of launching it on the water and sinking it in the required position. For this purpose the pipe was first laid out in sections alongside a light railway that ran down to the shore near the position it was intended to occupy. The sections were then raised on trolleys running on the track and were bolted together, special ball and socket joints being inserted at intervals to enable the pipe to take up the shape of the sea bottom at the place where it was to rest. Protection from corrosion was given by covering the pipe with two thick coatings of bitumen.



A pipe 1,880 ft. in length ready for launching into the sea at Cape Town. How this was done is explained in the accompanying article.

The delicate operation of launching the pipe was carried out on a fine afternoon at high tide. The pipe was filled with compressed air and was then pulled slowly forward by means of a steel cable hauled in by a motor winch. As it entered the water each section in turn floated off its trolleys, natives retrieving these and bringing them to shore. Finally the entire pipe was afloat, the joints enabling it to rise and fall easily with the waves, and it was then hauled gradually into position for joining to the shore section.

The engineer in charge was stationed on a specially constructed platform from which he had an excellent view of the operations, and he gave his instructions by means of a microphone and portable wireless receiving sets stationed at different points. When darkness fell the pipe was still unconnected. Acetylene flares were lit and the searchlight of a harbour tug was directed on to the scene to enable the work to be carried on, however, and by about 11.0 p.m. all was ready for sinking the pipe. The air in it was released and water pumped in to take its place. Gradually the pipe sank down on to its bed, which had previously been prepared by divers, and there it was firmly anchored in position, with its discharge end at a depth of 55 ft.

H. L. EDWARDS (Cape Town).

Scene during the launch of the pipe, showing the platform from which the operation was controlled.

Copper Mining in Cyprus

In the island of Cyprus there are important asbestos and copper mines that are well equipped with modern machinery. The copper mine is very old. Copper was obtained from Cyprus in very early times, the metal actually deriving its name from that of the island. The mines were originally worked by the Phœnicians and the Egyptians, and later by the Romans, and the overgrown dumps of waste ore left by the ancient miners may still be seen.

A few years ago the site of an ancient copper mine was rediscovered by an American surveyor, and a company was formed to commence extraction operations. Before these were undertaken a jetty had to be constructed and a power house built, while railway lines were laid down for the transport of the ore and houses were erected for the accommodation of the employees.

The mine is in a hill and the entrances to most of the levels are simply cut straight in from the slopes. As the galleries are driven into the earth they are lined with cement sections fastened together. The various levels are connected by narrow vertical shafts and in these ordinary ladders are fixed to enable mine workers to pass from one gallery to another. Ascents and descents of the ladders must be made in darkness, except for the illumination given by the small flickering flame of one of the acetylene lamps carried by the miners, and opportunities of resting on the small platforms placed at intervals are greatly appreciated by those who are not accustomed to the mine.

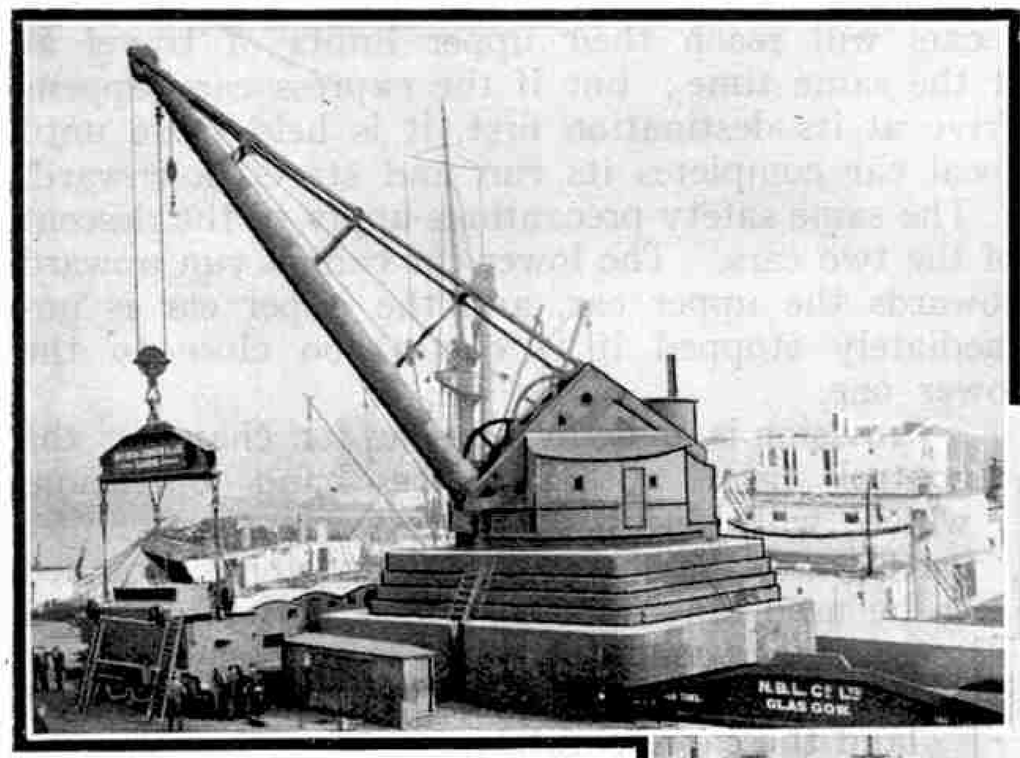
During recent operations old Roman galleries have occasionally been penetrated and relics of ancient miners unearthed. On both sides of these galleries are niches in which earthenware oil lamps were placed by the miners of Roman times, and in these huge crystals of metallic salts have since been formed.

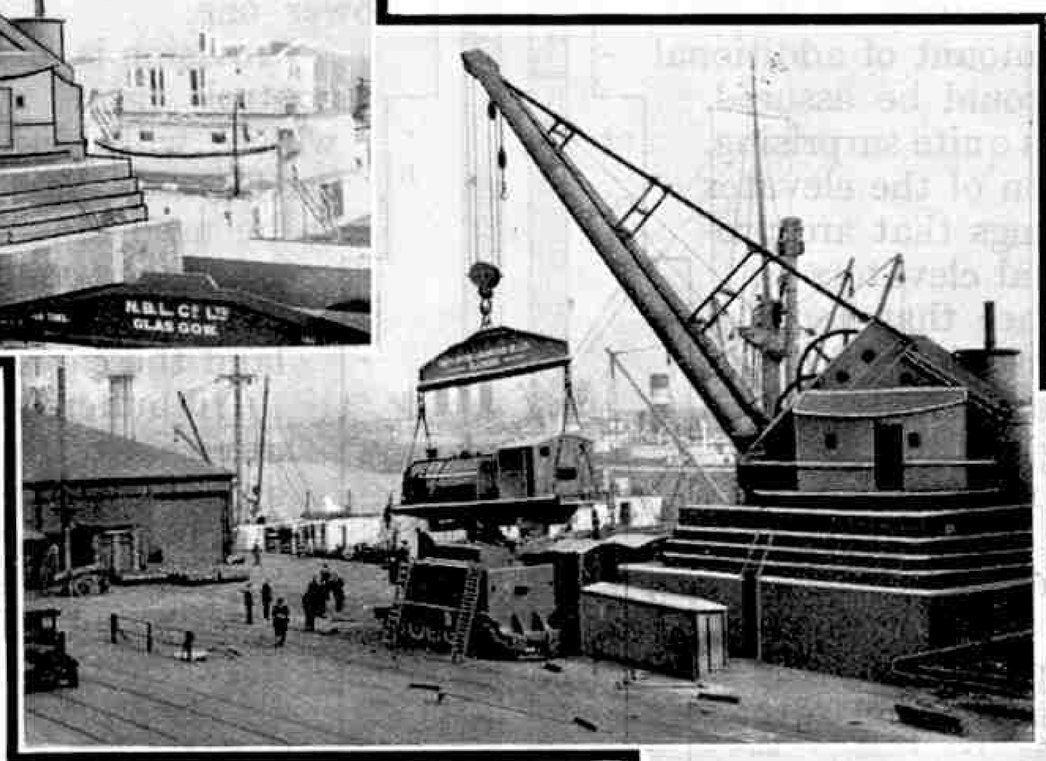
The ore extracted from the mine is transported by means of lighters to steamers in the bay for shipment to Europe.

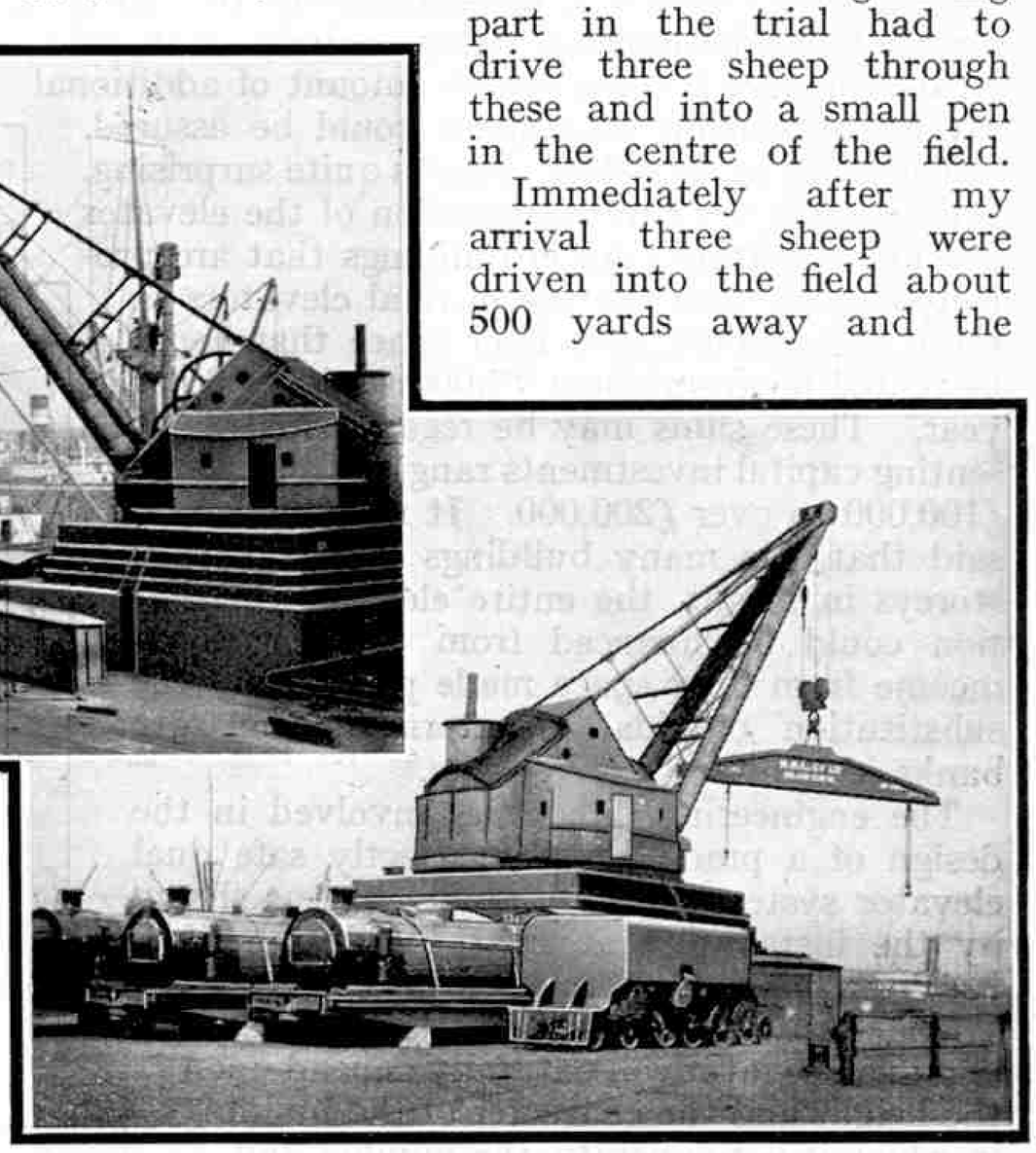
REGINALD ALLEN (London, N.20).

Garratt Locomotives for East Africa

Locomotives built in this country for overseas railways are now usually shipped almost in complete running order instead of in parts. This avoids the necessity of sending a squad of men abroad to supervise their erection. An interesting illustration of this tendency was the recent shipment of 4–8–2+2–8–4 "Garratt" locomotives constructed by the North British Locomotive Company Ltd., Springburn, for the Kenya and Uganda Railway. These locomotives were the first of their type ever built in Scotland, and I took part in the interesting task of arranging the lifting tackle necessary in loading the three engines of the first batch in the *"Clan Skene,"* a vessel of 3,233 tons in which they made the voyage to East Africa.







"Garratt" locomotives, built by the North British Locomotive Company Ltd. for the Kenya and Uganda Railway, being loaded on the "Clan Skene" for shipment to East Africa. The middle photograph shows the hoisting on board of the boiler unit of one engine, and above and below other units may be seen being prepared for shipment.

The engines could not be shipped complete, of course, for they are 81 ft. in length. Instead each was forwarded in three sections that could readily be fitted together. These consisted of the boiler unit and the front and rear engine units respectively. The weight of a single boiler unit was a little more than 40 tons, and that of each engine unit about 30 tons. They were taken to the dock side on a large trolley wagon drawn by two steam tractors.

The boiler unit of one of the locomotives was the first to leave the works. The 90-ton overhead crane with which the erecting shop of the Company is equipped easily lifted it and traversed the full length of the shop to lower it on to the waiting trolley. The tractors then hauled this out of the works, and in spite of their heavy load they kept pace with ordinary traffic on the road to the docks.

On arrival there, another giant crane removed the unit from the trolley to wooden blocks previously arranged for its support. The ease with which this part of the proceedings was carried out gave no hint of the careful measurements and other preparations that had been necessary before commencing work.

The tractors made nine journeys to and from the works with the sections of the locomotives to be forwarded in the *"Clan Skene."* The only dismantling necessary consisted in the removal of the oil tanks on the rear engine units. These were a little too high to enable the trolley carrying them to pass through the works gates. They were easily removed, however, for they are only held in position by means of a few bolts, and they were quickly replaced on arrival at the quay side.

By the time the sections had been assembled at the docks the *"Clan Skene"* had berthed alongside and loading commenced. The engine units were stowed in the forward hold of the vessel. There was very little margin in passing them through the hatches, but they were lowered into position without mishap. The boiler units were easily dealt with, for they were carried as deck cargo. D. W. CHISHOLM (Glasgow).

A Caithness Sheep Dog Trial

Recently I spent an enjoyable afternoon at a sheep dog trial in the north of Scotland. When I arrived at the scene of the trial I saw that dotted about the field were a number of small obstacles in the form of fences with gaps in them. Each dog taking part in the trial had to drive three sheep through these and into a small pen in the centre of the field.

Immediately after my arrival three sheep were driven into the field about 500 yards away and the first competitor took up his position. He waved his hand and in obedience to the signal his dog raced away, making a wide detour in order to avoid startling the sheep. He then drove them gently towards the first obstacle, his master giving him orders either by whistling or by making signs with his arms.

All went well until the dog brought the sheep to the pen. Then the trouble began! The animals would not enter and the longer the man and dog tried to persuade them to do so, the more obstinate they seemed to become. Eventually they were safely enclosed, however, and other dogs then came forward, the animals displaying remarkable sagacity.

One dog caused great amusement—even to its owner—by refusing to bring in the three sheep set apart for it. Instead it leaped a dyke, or stone wall, and came back with sheep from another field! When it realised what was wanted it went through the trial very well. J. G. HUTCHINSON (Edinburgh).

Two Elevator Cars in One Shaftway

Installation for 20-Storey Building

AN elevator of a new type, with two cars operated separately in the same shaftway, has been built by the Westinghouse Electric Company and placed in regular service in their main office building at East Pittsburgh, U.S.A. This dual elevator is the first actual installation of its kind.

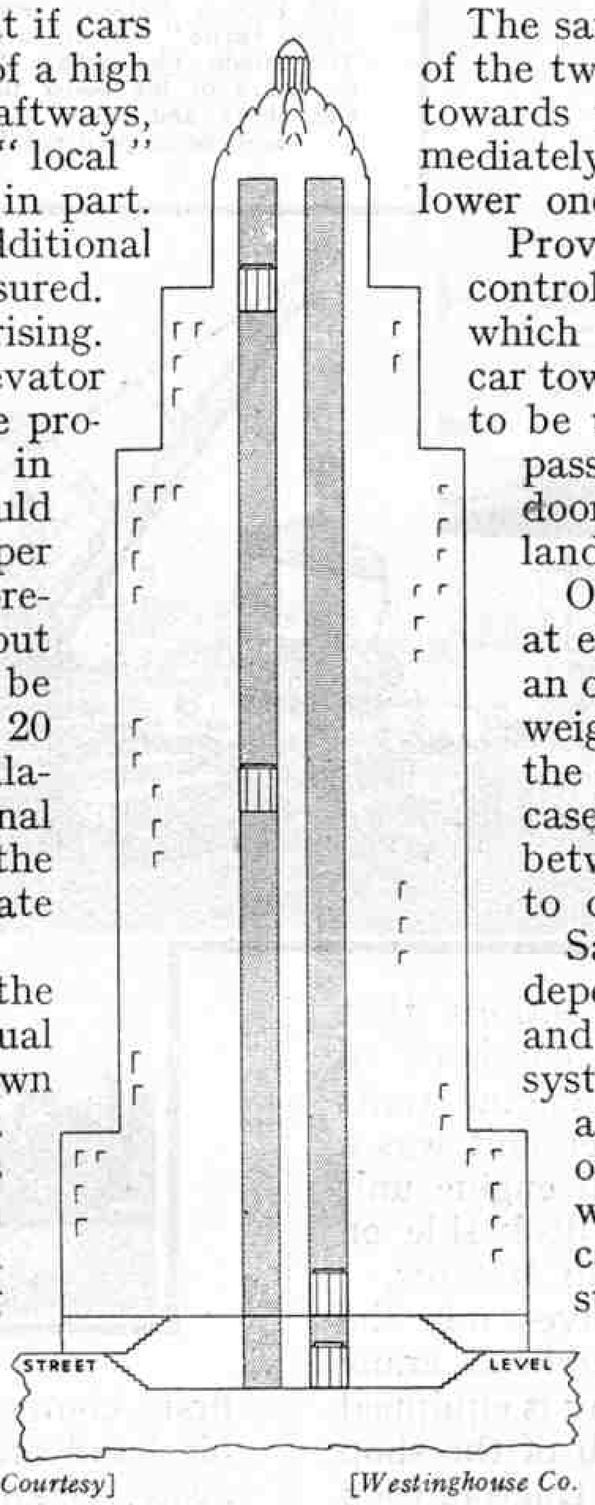
In a description of the elevator, Mr. H. D. James, consulting engineer of the Westinghouse Electric Elevator Company, says it has long been obvious that if cars serving both the upper and the lower floors of a high building could be operated in the same shaftways, the shaftways now devoted exclusively to "local" service could be omitted either entirely or in part. In this manner a considerable amount of additional revenue-producing floor space could be assured.

The value of such floor space is quite surprising. For example, careful examination of the elevator layouts of certain typical buildings that are projected shows that the use of dual elevators in these cases would save floor space that could be rented for from about £7,000 to £17,000 per year. These sums may be regarded as representing capital investments ranging from about £100,000 to over £200,000. It may indeed be said that, for many buildings more than 20 storeys in height, the entire elevator installation could be financed from the additional income from floor space made possible by the substitution of dual elevators for separate banks of local and express cars.

The engineering difficulties involved in the design of a practical and perfectly safe dual elevator system are very great, but, as shown by the installation at East Pittsburgh, it has been possible to solve these difficulties satisfactorily. The details of the operation of a dual elevator will naturally depend upon the height and the character of the building in which it is to operate, the number and speed of the elevators, and other conditions. The following are some of the most important features of an installation for a 20-storey building, and the explanation will be made quite clear from examination of the accompanying sketch.

The upper car of the two is the express car. It starts from the street level and, running without a stop to floor 11, serves the floors from that point to the top. It is entirely unrestricted as to its operation, except that it is automatically prevented from running downward while the lower car is running upward.

As soon as the express car is out of the way, the lower or local car, which has been waiting at a basement level, rises to the street level and then proceeds to serve the lower 10 floors. It also is unrestricted, except in one important respect; namely, that it cannot approach the upper car within a predetermined distance. If an attempt is made to run the lower car up against the upper one, it will automatically be slowed down and stopped at the proper point, and held there until either its operator runs it downward, or the upper car moves upward. Car operation is so timed that normally both cars will reach their upper limits of travel at about the same time; but if the express car happens to arrive at its destination first, it is held there until the local car completes its run and starts downward.



Courtesy [*Westinghouse Co.*

Sketch showing the principle of dual elevator operation. In the right-hand shaft are the two cars, the "local" car at basement level, and the "express" car at street level, ready to carry up passengers. In the left-hand shaft the cars have reached their limit of travel, and are ready to descend.

The same safety precautions apply to the descent of the two cars. The lower car cannot run upward towards the upper car, and the upper car is immediately stopped if it comes too close to the lower one.

Provision is made in each car for changing the control from automatic to hand operation, which will permit slow movement of either car towards the other. This provision is intended to be used only as a matter of safety in case a passenger should be caught in the enclosure door, or if the automatic control did not land the car accurately.

Oil buffers stop the cars in the usual manner at either of their limits of travel. In addition an oil buffer is placed between the two counterweights to prevent shock if by any possibility the two cars should come together. In this case a set of emergency switches situated between the cars would come into operation to disconnect the electric power.

Safety is ensured by the use of three independent systems, one of which is electrical and the other two are mechanical. A signal system in each car informs the operator at all times of his own position and that of the other car, and also indicates exactly what is happening if for any reason his car should be automatically delayed or stopped. A green signal light indicates that the operator can run at full speed; an amber light is a caution signal, calling for half speed; and a red light means stop.

The dual elevator at East Pittsburgh serves 11 storeys. The cars operate at a speed of 600 ft. per minute, and each is capable of carrying a load of 3,000 lb. They are controlled by a full automatic push-button system that stops the cars automatically at the desired point. Aluminium is used extensively throughout the installation. The resulting saving in weight reduces the power consumption and the general stress on both structure and equipment, and thus reduces the cost of operation. The aluminium enclosure doors weigh only about half as much as steel doors of the ordinary type, and therefore the energy required to operate them is also approximately halved.

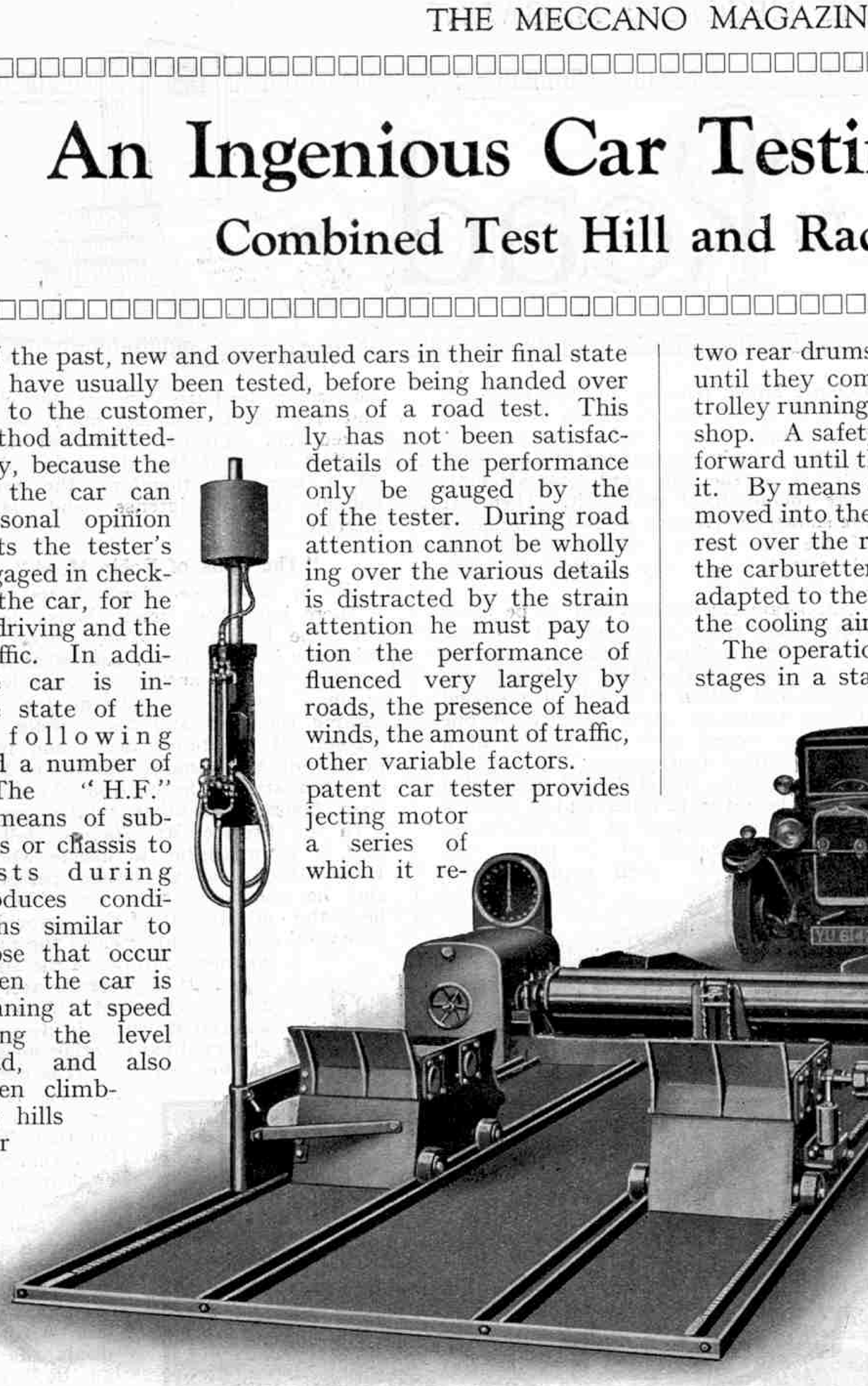
This system should help to solve a great skyscraper problem—that of economical vertical transportation.

An Ingenious Car Testing Machine

Combined Test Hill and Racing Track

IN the past, new and overhauled cars in their final state have usually been tested, before being handed over to the customer, by means of a road test. This method admittedly has not been satisfactory, because the details of the performance of the car can only be gauged by the personal opinion of the tester. During road tests the tester's attention cannot be wholly engaged in checking over the various details of the car, for he is distracted by the strain of driving and the attention he must pay to traffic. In addition the performance of the car is influenced very largely by the state of the roads, the presence of head or following winds, the amount of traffic, and a number of other variable factors.

The "H.F." patent car tester provides a means of subjecting motor cars or chassis to a series of tests during which it reproduces conditions similar to those that occur when the car is running at speed along the level road, and also when climbing hills or hauling heavy loads.



The "H.F." car testing machine, which indicates directly, without calculation, the horse-power, tractive effort, fuel consumption and retarding efficiency of each brake of a car or chassis. We reproduce this illustration by courtesy of Heenan & Froude Ltd.

The tester consists of a set of drums, all mounted on ball bearings, supporting the front and rear wheels of the car or chassis, one drum being directly coupled to a "Froude" dynamometer of the type that has been adopted in most parts of the world for testing automobile engines. The dynamometer is supplied with water from the mains, and it resists rotation of the drum to an extent that can be regulated by means of a single handwheel. The arm of the dynamometer pulls upon a weighing machine arranged to show direct and instant readings of the tractive effort and brake horse-power at the surface of the power drum.

A pair of ramps are mounted at the rear end of the plant so as to permit cars of varying wheel track to run up them under their own power. On reaching the upper end of the ramps the front wheels sink into the space between two rear drums. They do not remain there, but pass on until they come to rest on front drums mounted on a trolley running in tracks laid down on the floor of the test shop. A safety device prevents the trolley from moving forward until the front wheels have come safely to rest on it. By means of a hand winch, the car and the trolley are moved into the testing position, in which the rear wheels rest over the rear drums. A flowmeter is connected to the carburetter, and auxiliary cooling arrangements are adapted to the radiator to compensate for the absence of the cooling airstream experienced on the road.

The operation of the plant is simple, and the various stages in a standard testing programme are as follows. First of all the tyres are inflated to the pressure recommended by the makers. Then the vehicle is driven up the ramps until the front wheels rest on the front trolley, the brakes are applied, and the engine is switched off. Wire cables are quickly snapped into position round the rear axle, then tautened, and the brakes are released. The front trolley is drawn forward by the winch until the rear wheels rest upon the rear brake tester. The hand brake lever is then applied, the rear brake tester rollers are rotated and an instant reading is obtained of brake efficiency. After brake adjustment the rollers are again rotated, and the performance of the hand brakes is thus brought up to the desired standard. The pedal depresser is applied to the foot brake pedal so as to give the standard pedal pressure, usually 50 lb., and the rear foot brakes are checked in the same manner. Next the front wheels are set over the front brake tester rollers, and the performance of the front brakes is similarly brought up to standard.

Quick-acting auxiliary cooling arrangements are adapted to the radiator to reinforce the cooling action, and the petrol flowmeter is coupled to the carburetter union through a flexible pipe. The engine is now started, and the car is put through its power tests. During this operation the tester can feel, watch, and listen to every working part of the engine and transmission; carburetter and ignition settings can be regulated, and any other tuning adjustment made. The effect of any alteration is shown instantly upon dials that give readings, without calculation, of speed in miles per hour, tractive effort, brake horse-power reaching drums, and fuel consumption in miles per gallon.

Books to Read

On these pages we review books that are both of interest and of use to readers of the "M.M." We have made arrangements to supply copies of any of these books where readers find difficulty in obtaining them through the usual channels.

Orders should be addressed to the Book Dept., Meccano Limited, Old Swan, Liverpool, and 1/– should be added to the published price of the book to cover the cost of postage. The balance remaining will be refunded when the book is sent, as postages on different books vary according to the weight and destination.

"The Paris Gun"

By H. W. Miller. (Published by Harrap. 10/6)

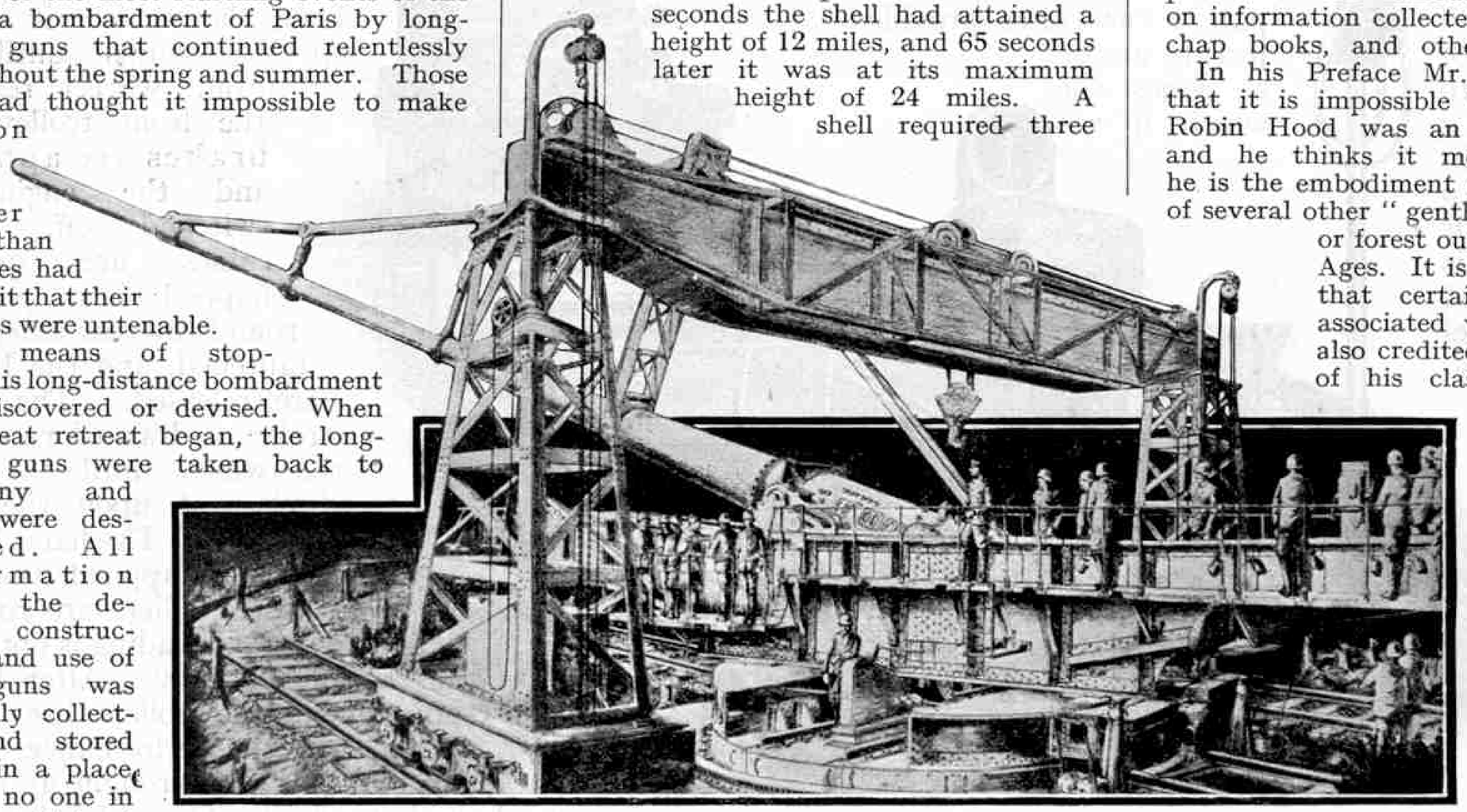
At 7.20 on the evening of the 23rd March, 1918, the inhabitants of Paris were alarmed and horrified by the bursting of a huge shell, which it was later found had been fired from a gun 75 miles away. The bursting of this shell marked the opening of one of the most startling events of the War—a bombardment of Paris by long-range guns that continued relentlessly throughout the spring and summer. Those who had thought it impossible to make cannon with a greater range than 25 miles had to admit that their theories were untenable.

No means of stopping this long-distance bombardment was discovered or devised. When the great retreat began, the long-range guns were taken back to Germany and later were destroyed. All information about the design, construction, and use of the guns was carefully collected and stored away in a place where no one in the Allied nations would ever see it; to divulge any of this information was declared high-treason punishable by death. In the Treaty of Versailles the Allies demanded that one of the long-range guns should be delivered with full information concerning its design and use, but neither the gun nor the information was ever delivered. Only two Germans have ever written on the subject, and their description is so vaguely and so discreetly worded as to reveal nothing.

After ten years of painstaking study and persistent search in forgotten files, the whole story has been pieced together by Colonel H. W. Miller, who served through the War as Chief Engineer in the heavy artillery of the American Expeditionary Forces. In this book he presents a full account of the great German offensives of 1918, of which the bombardment of Paris with these long-range guns was a carefully planned and vital part. Colonel Miller tells of the excitement in Paris in those days of March 1918 when the bombardment started; how the experts quickly determined the probable location of the gun, and how attempts were made to "spot" it. Then we are shown the German side—the designing of the guns; the building of the emplacements; and the precautions taken to conceal them.

Elaborate calculations had to be made when firing these great guns—a pressure of over one million pounds was exerted on the base of the shell as it left the muzzle and within a fiftieth of a second it was travelling at a velocity of one mile per second with the energy of a billion foot pounds! Within 25 seconds the shell had attained a height of 12 miles, and 65 seconds later it was at its maximum height of 24 miles. A shell required three minutes to travel from the gun to its bursting in Paris. After the first shell had been fired an examination was made of the special instruments, used for the first time in heavy artillery work, to discover the correct weight of powder to be used for the next charge. According to the range table, the total pressure should have been 59,000 lbs. per square inch for the corrected range of 67.1 miles, but the instruments showed that the pressure had only been 53,800 lbs. and accordingly the next and subsequent charges were increased by 7½ lbs. of powder.

The bombardment of Paris was one of the most spectacular bombardments in history, and even surpassed the destruction of the supposedly impregnable turret fortifications of Liége early in August, 1914, by new and previously unheard-of German guns. As the files concerning the Paris guns are now closed, and the secret papers more securely locked and guarded, there will not be another story of this dramatic subject. As a war-book therefore, the present volume is of intense and special interest.



The Paris Gun and Carriage in position ready for action. From "The Paris Gun" reviewed on this page.

"The Book of Robin Hood"

By A. L. Haydon. (Fredk. Warne. 6/–)

There have been many books dealing with the legends of Robin Hood, but this book is written on a somewhat different line, for the author has gone to the original sources of information concerning the hero and his exploits. His account of the brave deeds and merry pranks of the famous outlaw is based on information collected from old ballads, chap books, and other similar sources.

In his Preface Mr. Haydon tells us that it is impossible to decide whether Robin Hood was an actual personage, and he thinks it most probable that he is the embodiment of the personalities of several other "gentlemen of the road" or forest outlaws of the Middle Ages. It is generally accepted that certain of the stories associated with his name are also credited to other notables of his class. Whether or not this is the case, it is certain that Robin Hood will always be dear to us as a romantic figure, and for this reason alone we are glad to renew our acquaintance once again with his "deeds of derring do," even though our author shows him as less of a superman than is usual in most records of his career.

The book is admirably illustrated with 12 plates in colour and readers will find it a story of stirring interest.

"The Wheelwright's Shop"

By George Sturt
(Cambridge University Press. 2/6 net)

This delightful little book is the first of a series in which the stories of practising craftsmen are to be recorded in order to reveal as far as possible the personality of the workman, and to show the man himself engaged in the many interesting details of his work. In it the author explains how farm wagons were designed to suit their special purposes, and built up by the wheelwright from carefully selected and seasoned wood. He tells the story with a love for his trade that was a mark of the old master craftsmen.

"Automobile Engines"

By A. W. JUDGE, A.R.C.S. (Chapman & Hall. 4/- net)

This is one of a series of motor manuals in which the construction, care and maintenance of motor cars of all types are dealt with. The present volume deals fully with the engines used in motor cars. It is, of course, principally concerned with the petrol engine, but in view of the increasing importance of the Diesel type, which is now being adapted for use in road vehicles, this is given special attention.

A preliminary chapter deals with the combustion of petrol and other fuels used in internal combustion engines, and explains the series of operations in the four-stroke cycle. Then follow sections dealing with the mechanical details of petrol engines of various types, including motor cycle engines of one and two cylinders, in addition to those with a larger number of cylinders employed in motor cars. All well-known types are described, including double and single sleeve engines; and an interesting section describes a number of unusual types, among them the Bradshaw oil-cooled engine and the swashplate engine. The final chapters deal fully with lubrication and cooling, and the book concludes with sections on engine testing and tuning.

The book is packed with information, and will be found extremely useful by those who wish to learn the principles on which motor car engines are built and run. It is well illustrated by a large number of photographs and instructive diagrams.

"A Tribute to Michael Faraday"

By ROLLO APPLEYARD. (Constable & Co. Ltd. 7/6)

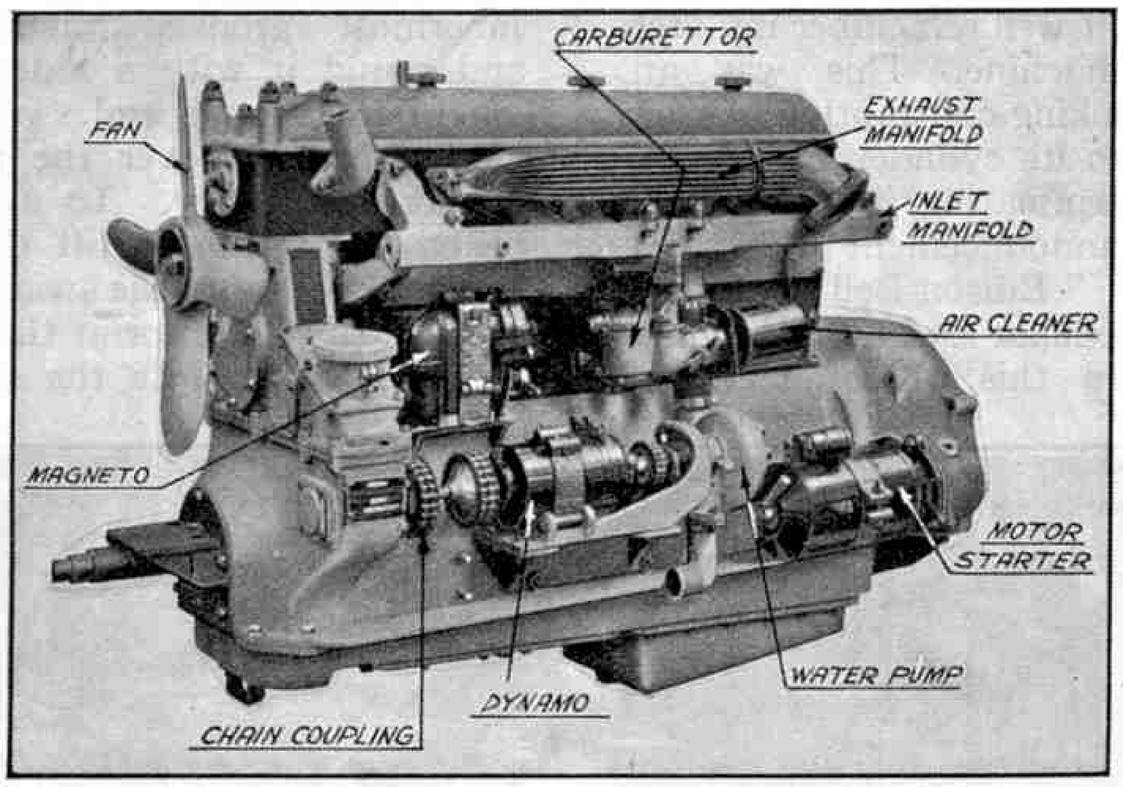
Faraday's discovery on 29th August, 1831, of the principle of the dynamo, undoubtedly was one of the great events of history, for it introduced a new source of power to the world and led ultimately to the foundation of the great modern industry of electrical engineering. The centenary of the discovery, which was celebrated in a series of meetings held in London during September, has aroused interest in the life of its author, and the aim of this book is to describe his wonderful career.

While doing justice to Faraday's remarkable scientific work, Mr. Appleyard directs special attention to his ideals and the value of his teaching and example. The greater part of the book is therefore concerned with events in Faraday's career that show how his character developed. The boyhood of the great scientist is described as fully as our knowledge of his early days permits, and many interesting new facts are revealed concerning the Yorkshire families from which he sprang. The author traces the beginning of the boy's aspirations for a better career than that of a bookbinder, engaged in what he regarded as sordid trade affairs. He tells how the self-educated youth first satisfied his desires for scientific employment by entering the service of the Royal Institution as a laboratory assistant, and then became fitted for his future position by means of a long tour of the Continent as the companion of Sir Humphry Davy, then Britain's foremost chemist.

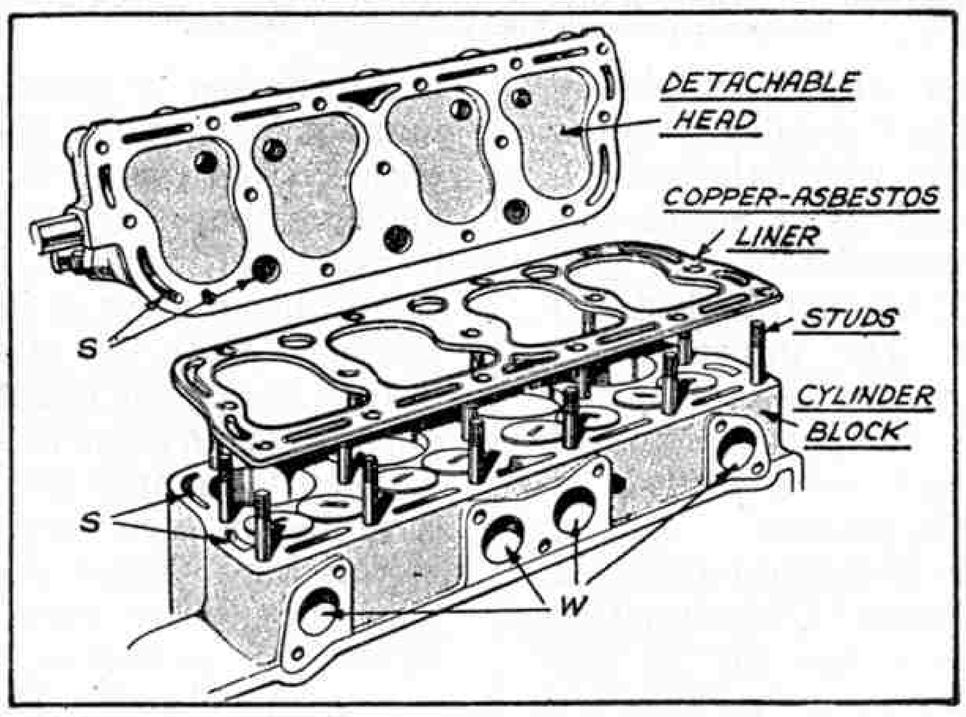
As a great scientist Faraday exercised a wonderful influence over his fellow countrymen. He was consulted on many technical questions of the greatest importance in public affairs and in industry, but in addition there was something in his character and in the charm of his manner that made him one of the most revered figures of his age. For many years the well-known lecture room at the Royal Institution was crowded whenever he gave one of his inimitable discourses, whether he was describing the results of his latest researches on complicated electrical phenomena, or telling the simple story of the making and burning of a candle, in one of the Christmas lectures arranged every year for the benefit of young people. His correspondence with other scientists, and with many friends who were less interested in his experimental work than in the man himself, shows the greatness of his mind and helps to explain why he occupied such a unique position. To this side of Faraday's career the author devotes a considerable proportion of his space, and the chapters containing it are very fascinating.

Finally Mr. Appleyard turns to the laboratory work of Faraday. It was there that this great man was most at home, for undoubtedly he was one of the most remarkable experimental scientists who have ever lived, and was always at his best when trying out in the laboratory the ideas that had come to him overnight as a result of his previous work. Mr. Appleyard very wisely allows the story of this interesting phase to be told by Faraday himself, and included in the book are many extracts from the laboratory notebooks in which he described his researches, and also from the letters in which he summarised his results for the benefit of his correspondents at home and abroad. These will be read with the greatest interest, for they illustrate how perseveringly Faraday followed up every clue, however slight, that would help to throw light on the problems with which he was concerned.

The book contains many excellent illustrations. There are two portraits of Faraday himself, together with reproductions of paintings and drawings showing the laboratories in which he worked. Several photographs of the actual apparatus that he employed are also included. Most of this was constructed by Faraday himself, who not only made the coils with which he carried out his epoch-making experiments, but even wound the insulating covering on the copper wires that he used for this purpose. Faraday's coils and other apparatus that he employed are carefully preserved among the treasures of the Royal Institution, in the service of which the great discoverer spent his life.



The Leyland six-cylinder commercial type engine. (See below).



The detachable head and liner of the Morris Cowley engine. From "Automobile Engines" reviewed on this page.

"Book of the Morgan"

By G. T. WALTON

(Sir Isaac Pitman & Sons Ltd. 2/6 net)

This little book has been written for the benefit of owners and prospective purchasers of Morgan Runabouts. In it the author deals with the entire range of the well-known three-wheeled vehicles that have been developed from the first Morgan Runabout produced in 1910. Brief descriptions of these are followed by useful information regarding licences, the registration of motor cars, and other necessary details, after which questions of running costs and the driving and running in of the cars are discussed. The author explains clearly the procedure necessary for keeping the engine and transmission gear in repair, and gives instructions for overhauling these and for obtaining the best results under various conditions. Although the book deals with a unique type of motor vehicle, owners of motor cycles and of small motor cars generally will find much in it that will be of interest to them. The book is well illustrated by useful diagrams.

"The Mechanism of Nature"

By E. N. DA C. ANDRADE. (Bell. 6/-)

Professor Andrade, already known to our readers as the author of an interesting book on the steam engine, has written this book to explain as simply as possible the modern views on such abstruse subjects as the structure of matter and radiation. There are chapters about heat and energy, sound and vibrations, light and radiation, electricity and magnetism, the quantum theory and the atom.

The author not only deals with the latest developments of physics in their several fields, but shows many of the practical uses of the science in modern civilisation. The book is a welcome diversion as well as a timely explanation of some of the great mysteries of modern science.

Our Gramophone Page

By "Tone Arm"

THE gramophone is one of the many inventions that have developed within the past half-century from interesting toys to mechanically perfect machines in daily use all over the world. I well remember my first experience with a talking machine. This was an Edison phonograph, a quaint-looking contraption housed in a glass case. One listened to its cylinder records by means of thin rubber tubes terminating in ear pieces. The music was preceded by an announcement of its title, followed always by the words "Edison-Bell Record," delivered in a small tone of a peculiar and unforgettable quality. The contrast between this quaint machine and the modern gramophone is truly extraordinary. Even the cheapest present-day machines are good, while those of the best quality are musical instruments capable of reproducing anything from a song to a symphony with the utmost fidelity to the original.

Side by side with the development of the gramophone has proceeded the improvement of the record. One of the worst of the many defects of records made up to 1922 was an irritating scratch that accompanied the music and often completely spoiled it. In that year, however, the Columbia Graphophone Company introduced records in which the scratch was almost entirely eliminated, and as a result the record-buying public increased immediately. A still greater advance was made in 1925, when the electrical recording process was instituted. The improvement brought about in this manner was enormous, and it can only be appreciated to the full by comparing some of the old mechanically-produced records with records of the same artists made by the electric process. Among the many points of superiority of the electrical record is a great increase in the volume of tone. Unfortunately the record manufacturers have gone too far in this direction, with the result that many recent records are overpoweringly loud when played in a small room. No doubt a happy medium will be attained before long.

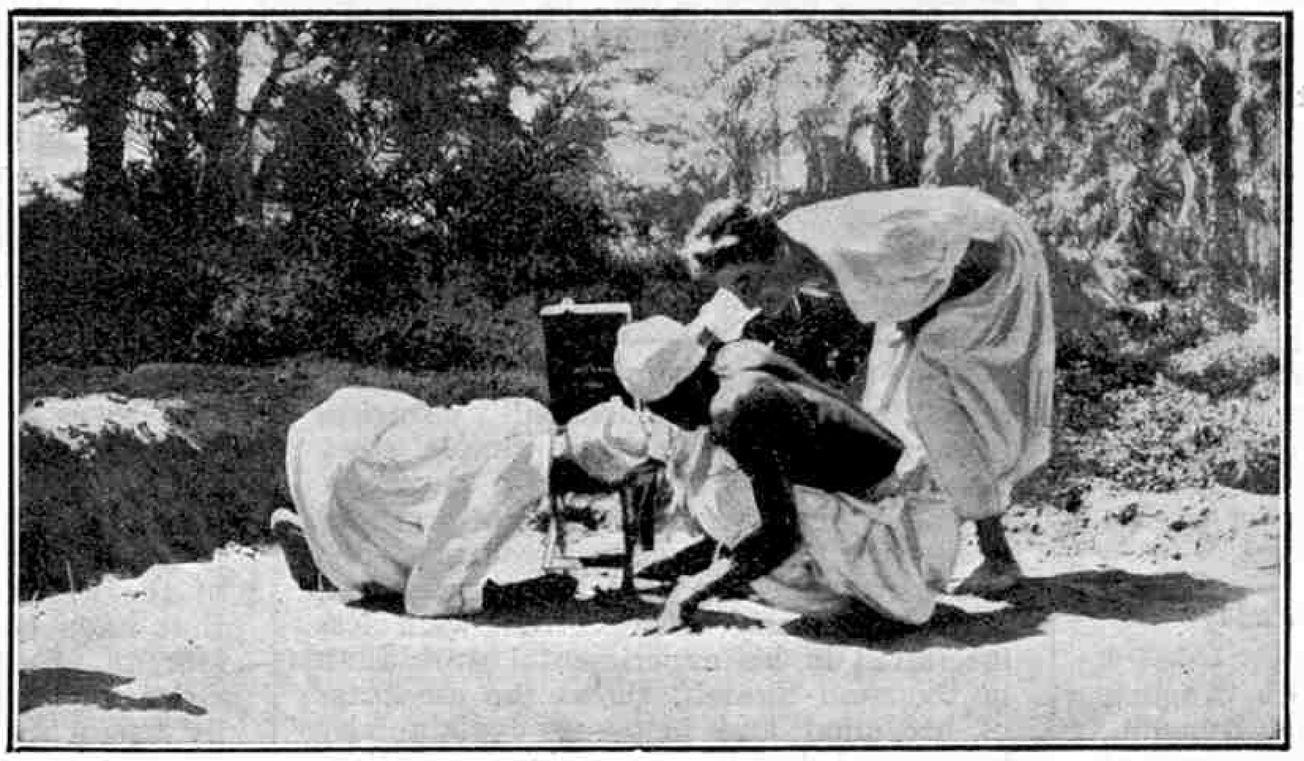
An interesting feature of the newer records is their thinness. In looking through my old records recently I came across two made by that wonderful violinist the late Eugene Ysaye, and autographed by him. These are fully as thick as two of the latest records put together. I do not know how old these Columbia records may be, but they must have been made of sterling stuff, for although they have been played scores and scores of times with all kinds of needles, they still reproduce quite well.

One other feature of importance in present-day records is the safety groove provided at the termination of the music. In the old days the needle, on reaching the innermost groove, might continue running round and round it with a hideous noise, or it might jump out of the groove and swerve across to the other side, jarring its way over the record, and ruining it more or less completely. To avoid this danger one had to be on the watch to lift the needle off the record immediately the music was finished. To-day there is no need to worry, for at the end of the record the needle will slide easily into the safety groove and run round it harmlessly until it is stopped.

During the past year or two the Editor has received many requests for articles dealing with the gramophone, but up to the present pressure on space has prevented anything being done in the matter. Now, however, room has been found for a monthly gramophone page, on which I shall describe how to obtain the best results from a gramophone and how to remedy the various defects that crop up from time to time. In many homes a gramophone is regarded purely as a musical instrument, the fact that it is a machine being entirely forgotten. It is certainly a very long-suffering machine, but there is a limit to the amount of neglect it can stand without losing efficiency.

Another matter of importance is the treatment of the records. Only too often these are to be found lying in untidy heaps on chairs, or on top of a piano, or else piled away anyhow in a cupboard. No attempt is made to keep them free from dust, and they quickly become scratched or even warped. Records subject to treatment of this kind cannot possibly reproduce well, and before long they deteriorate so much that they are thrown on one side as useless. In addition there is no system of arrangement with the result that the finding of a particular record often involves the turning over of disc after disc in one or more piles, which is very exasperating and generally results in careless handling of the records. I hope to show how easy it is to keep any number of records in perfect condition, and arranged in such a manner that any one can be found in a moment.

In addition, I shall refer to a few of the most interesting of the month's records. I do not propose to deal with purely dance records, or with those that appeal only to musicians, but with records of general interest that I can recommend to all readers.



Courtesy] [*Columbia Graphophone Co. Ltd.*

Looking for the singer! Natives at Ghat, on the border of the Sahara Desert, worried about the mysterious sounds from a Columbia "portable."

BRAINS AND BRAVERY

BOYS WHO RANK WITH MEN

TOWARDS the end of March of this year a violent blizzard swept over a great part of the United States. The western states suffered most severely, and during a raging snowstorm the temperature fell so low that several people were frozen to death. Among these were five children in Kiowa County, Eastern Colorado, members of a party of twenty-two who were returning home from Kiowa County School in an omnibus. The bus became snowbound, and the survivors of the party owe their lives to the courage and presence of mind of Bryan Untiedt, a 13-year-old boy, in whose care they were left.

The children were at school when the blizzard swept down upon their part of the country, and the teacher immediately decided to send them home. The driver of the omnibus in which they made their long journeys to and from the school did not like the idea of setting out in the teeth of the oncoming storm, but after some protest he did so. The result was disastrous, for the snow had drifted so heavily that fences were obliterated, and before long the omnibus was driven into a hidden ditch from which it could not be extricated.

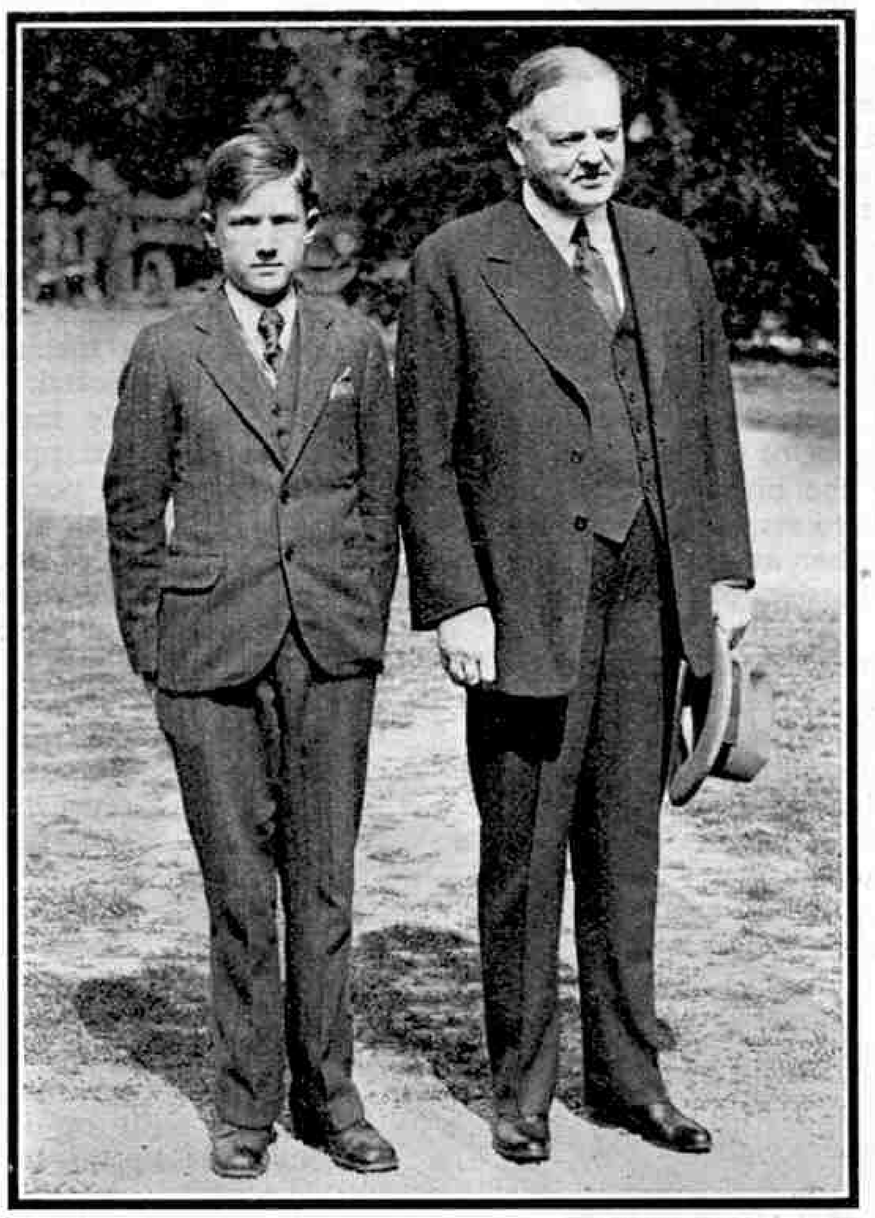
Then commenced a weary and anxious time. The driver devised a crude stove from a milk can, and in this he burned school books, the seats of the omnibus, and any other pieces of wood he could find, first soaking them in petrol in order to make them burn easily. These resources soon came to an end, however, and when the worn-out children eventually went to sleep the temperature had fallen so low that one of the girls was frozen to death during the night. In this desperate situation the driver determined to seek help as soon as daylight came. He explained the position to Bryan Untiedt, the oldest of the children, and leaving the remainder of the party in this boy's charge he started out to bring assistance. His effort proved to be another tragedy, for he fell into a snowdrift after covering only a few miles, and was frozen to death.

Ignorant of the driver's fate, the children huddled together for warmth, but the cold rapidly threatened to overcome them. Another girl died, and the remainder then became hysterical. In their frenzy a window was broken, and the interior of the omnibus was thus exposed to the cold air. It was then that Bryan's courage and good sense came to the rescue. He realised that they would all freeze to death if they remained still, and he set to work to keep everybody moving. He arranged boxing matches between various members of the party, and persuaded them all to play games that would keep them active. This was no easy task, for there were 19 children of various ages, all of whom required careful watching, and they were tired and weak after their long confinement in the omnibus, practically without food. Bryan persevered, however, and with such good effect that for a time further casualties were prevented. At one time death threatened his younger brother and a girl, but Bryan succeeded in saving them by taking off almost the whole of his own clothing in order to provide life-saving warmth for these younger children.

Bryan continued to stimulate and encourage the children as long as possible, but presently his most desperate efforts failed to prevent some of the children from falling asleep, and he himself could no longer keep awake. Fortunately at this moment, when the entire party seemed doomed to freeze to death, the stranded omnibus was discovered by a rancher who was looking for cattle that had become snowbound in the blizzard. He immediately summoned help, and after great exertions the children were removed to his little ranch house, where everything possible was done for them. By this time, however, three more had died, and the survivors were suffering from acute pneumonia and were severely frost-bitten. They were clearly in urgent need of treatment. Aeroplanes fitted with skis were the only possible means of transport, for the ground was deeply covered by snow. Machines were quickly summoned, and the children were taken to hospital with all possible speed.

There is no doubt that the disaster would have been far more serious but for the pluck and presence of mind of Bryan Untiedt. He himself did not escape uninjured, for he was so severely frost-bitten that for some time it was thought that amputation of his limbs could not be avoided. Fortunately he pulled through, however.

When President Hoover heard of Bryan Untiedt's splendid bravery he invited him to stay at the White House, the official residence at Washington of the Presidents of the United States. After about three weeks in hospital Bryan was sufficiently recovered to make the journey to Washington, where he was given a very cordial reception on his arrival at the White House. It is interesting to note that while there Bryan had the room that had been occupied by Colonel Lindbergh after his famous trans-Atlantic flight. One of the cherished ambitions of every American boy is to be a White House guest of a President, and during Bryan's privileged stay at the famous residence he was no doubt envied by millions of boys in the United States.



Photo] [*Acme Newspictures*

President Hoover on the lawn of the White House, Washington, with Bryan Untiedt, the boy hero who saved the lives of 19 children in a blizzard in Eastern Colorado.

New Meccano Models

Three-engined Monoplane—Tipping Steam Wagon—Archer—Derrick

ONE of the most popular types of passenger-carrying aeroplanes in use to-day is the multi-engined high-wing cabin monoplane. Machines of this type are employed extensively on the Continental Air Lines, and also in America.

The model shown in Fig. 1 although of comparatively simple construction, reproduces many of the chief features of a three-engined monoplane, and it forms an interesting addition to the already large selection of Meccano-built aircraft.

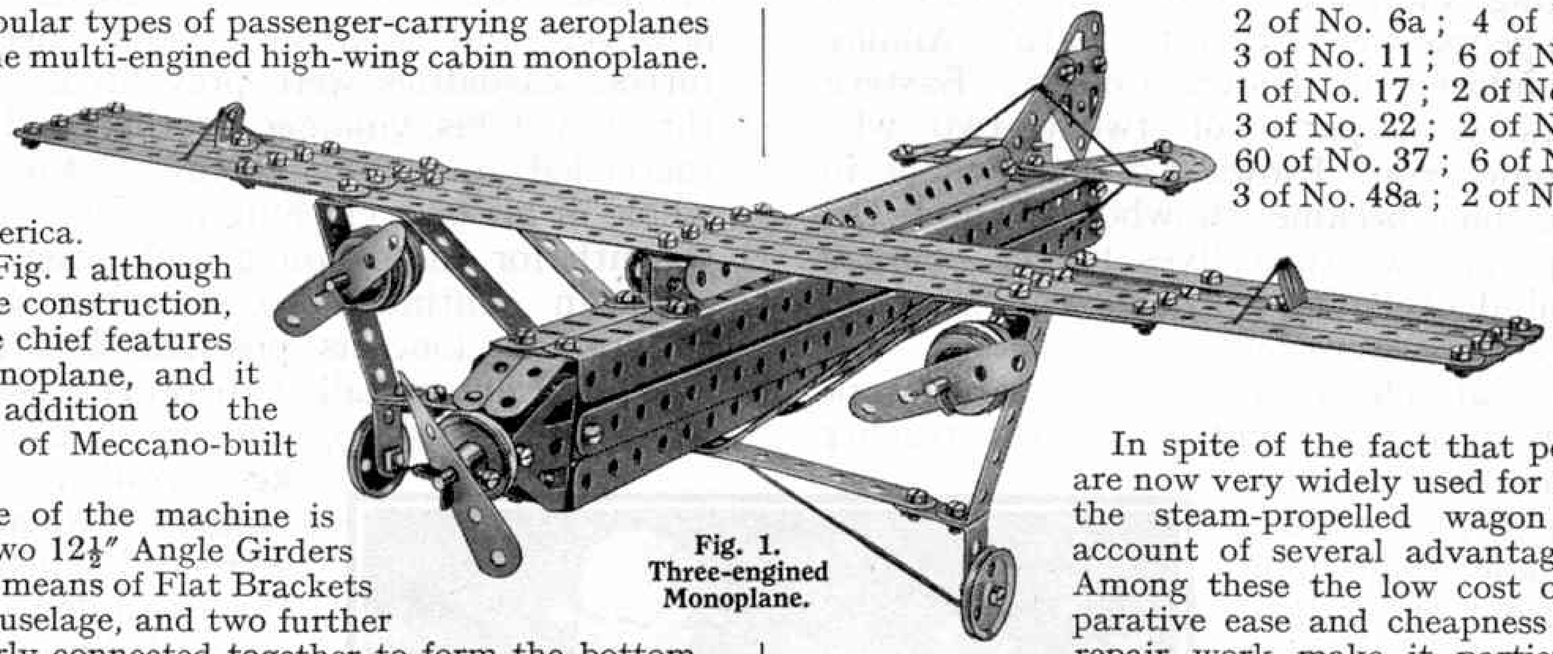


Fig. 1. Three-engined Monoplane.

The tapered fuselage of the machine is built up as follows. Two 12½″ Angle Girders are secured together by means of Flat Brackets to form the top of the fuselage, and two further 12½″ Girders are similarly connected together to form the bottom. These pairs of Girders are held together at the tail by means of further Flat Brackets, and a 12½″ Strip is also attached at each side. At the nose, the Angle Girders are spaced apart at one side by a 1½″ Strip. The Trunnions are held in place by means of Angle Brackets, and a Double Bracket is secured between the Trunnions to provide a bearing for the short Axle Rod that carries the centre engine, a 1″ Pulley, and its accompanying propeller. Two short Strips are attached to the top and bottom pairs of Girders and are bent slightly downward so as to complete the nose. The upper part of the cabin is made up of two composite strips consisting of 5½″ and 2½″ Strips overlapped and bolted together, and two Reversed Angle Brackets are bolted to the top Angle Girders of the fuselage, to complete this portion.

The wing of the model is composed of three 12½″ Strips and six 5½″ Strips overlapped and bolted together. The complete wing is secured at its centre to a 2½″ Strip, which in turn is bolted to the ½″ Reversed Angle Brackets mounted on the top of the fuselage. The wing is further supported at each side by 5½″ Strips, bent as shown and bolted to the lower pair of Angle Girders of the fuselage. Each engine nacelle is composed of two ¾″ Flanged Wheels and a 1″ Pulley, all three wheels being mounted on a short Rod, while a 2½″ Strip held in place by means of a Spring Clip does duty for a propeller. Each nacelle is suspended from the underside of the wing by a Reversed Angle Bracket. One lug of the Bracket is bolted to the wing and the other is secured to the side of the boss of the rear ¾″ Flanged Wheel by means of its set-screw, washers being used so that the lug of the Bracket is gripped tightly. The aileron control standards to the wing must not be overlooked; they are represented by Angle Brackets and short lengths of cord.

The tail plane and rudder are built up from 2½″ Strips and Curved Strips, the rudder itself consisting of two Flat Trunnions and a 2½″ Strip. Lengths of cord to act as bracing should be attached as shown in the illustration.

In order to build the model monoplane the following parts will be required: 6 of No. 1; 14 of No. 2; 2 of No. 3; 12 of No. 5; 2 of No. 6a; 4 of No. 8; 6 of No. 10; 3 of No. 11; 6 of No. 12; 2 of No. 12a; 1 of No. 17; 2 of No. 18a; 4 of No. 20b; 3 of No. 22; 2 of No. 22a; 4 of No. 35; 60 of No. 37; 6 of No. 37a; 2 of No. 38; 3 of No. 48a; 2 of No. 90a; 6 of No. 111c; 4 of No. 125; 2 of No. 126; 2 of No. 126a.

Tipping Steam Wagon

In spite of the fact that petrol-engined vehicles are now very widely used for commercial purposes, the steam-propelled wagon holds its own on account of several advantages that it possesses. Among these the low cost of fuel and the comparative ease and cheapness of maintenance and repair work make it particularly suited to the needs of certain industries, and some of the recently-designed types are capable of remarkable performances.

The model steam wagon shown in Fig. 2 is of the type used by excavating engineers and contractors, and it is fitted with a power-operated tipping mechanism whereby the contents of the hinged body may be ejected.

Each main side member of the chassis consists of two 12½″ Angle Girders overlapped seven holes. The front axle is duplicated for strength, each portion consisting of two 5½″ Strips overlapped nine holes and bolted to one side of the leaf springs. Each of the latter consists of one 3½″, one 2½″, and one 1½″ Strip, a ⅜″ Bolt passing through all three Strips serving to secure the spring to the axle. The ends of the Springs are secured to Angle Brackets, the front Angle Brackets being mounted on a Rod 1 (Fig. 3) carried in Trunnions bolted to the chassis. The rear Brackets have Flat Brackets attached pivotally to them by lock-nutted bolts and mounted on a Rod in a similar way to the front ones. The Springs for the rear Wheels are constructed and mounted in an exactly similar manner to the front springs.

The equalising beams of each bogie are two 4½″ Strips connected at their centres by 1″×1″ Angle Brackets 2. Each pair of equalising beams pivots freely about an 8″ Rod 3, which is passed through Collars attached by ⅜″ Bolts to the Springs. The steering gear is based on the correct Ackermann principle and is built up in the following way. The stub axles are secured in Couplings 4, which are free to turn about ¾″ Bolts inserted in their centre holes and attached by double nuts to the extremities of the front axle. The track rod (which connects the Wheels so that they turn together) is attached pivotally by means of Swivel Bearings 5 to the ends of short Rods that are held in the end bores of the Couplings. The free end of one of these Rods carries a third Swivel Bearing 6, which is connected by a Rod to a Double Arm Crank

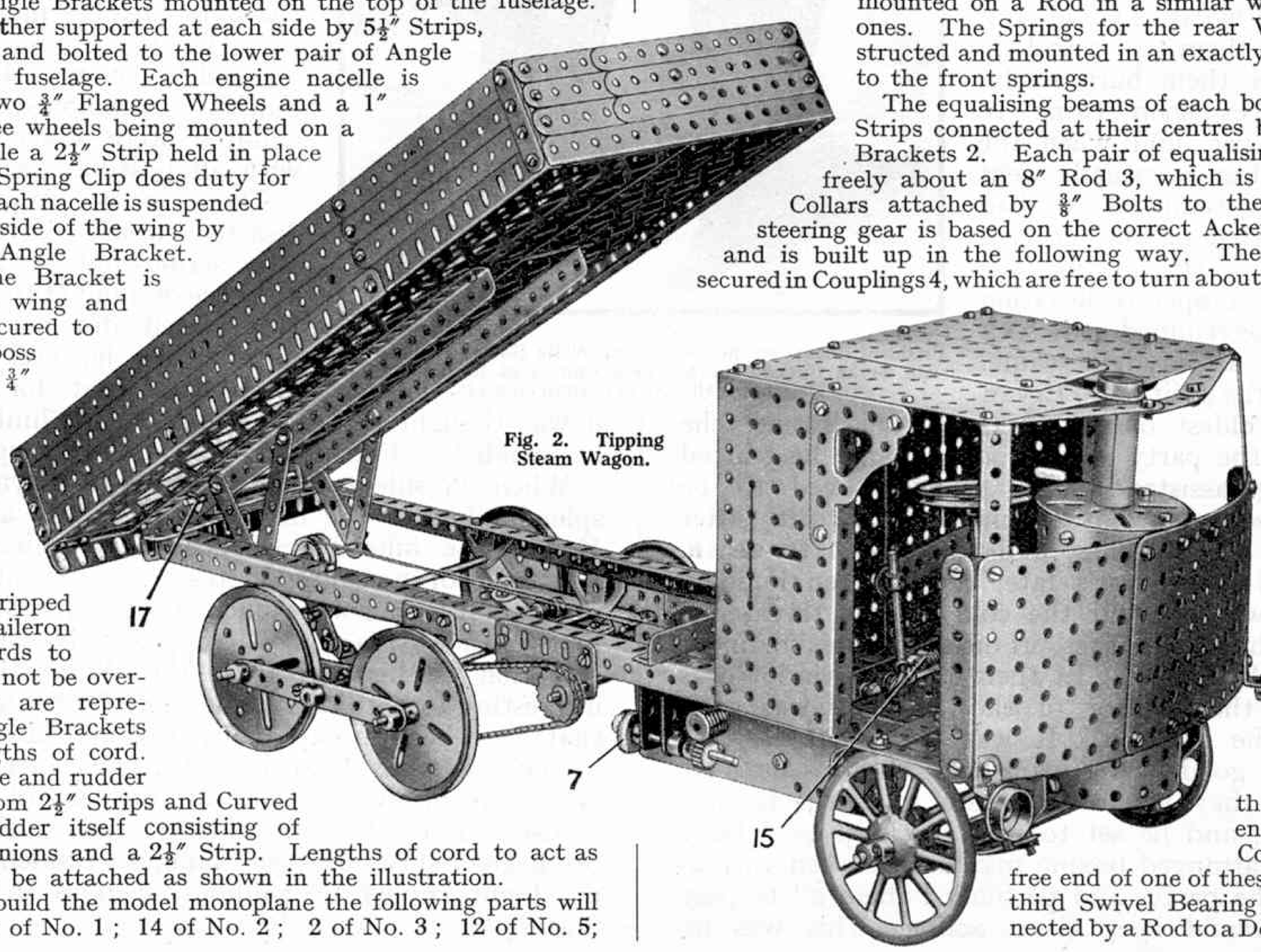


Fig. 2. Tipping Steam Wagon.

on the lower extremity of the steering column. The latter is journalled in a reinforced bearing consisting of a ½" Reversed Angle Bracket bolted to the floor of the cab.

The Motor armature spindle (see Fig. 3) carries a Worm meshing with a ½" Pinion on a Rod that has also a ¾" Contrate Wheel 7 secured to it. The Contrate Wheel is in constant mesh with a ½" Pinion on a sliding Rod 8. This Rod has two further ½" Pinions, one between and the other outside the Motor side plates, and by sliding it in its bearings the Pinions may be brought into mesh with either of the 57-teeth Gears 9 and 10. The Gear 10 is secured to a short Rod journalled in the Motor side plates and carrying also a 1" loose Pulley 11, which is retained in place on the Rod, together with a Flat Bracket, by Collars. One end of a length of cord is tied to the Flat Bracket and is passed over one of the 1" loose Pulleys 12 that are free on a Rod. This Rod is carried by Strips attached rigidly to the underside of the tipping body. The cord then passes to the Pulley 11, back over the second Pulley 12, and is attached finally to the Rod on which the Gear 10 is secured.

The Gear 9 is mounted on a 6½" Rod that passes completely through both Motor side plates and is also supported in additional bearings consisting of 2½" Flat Girders bolted to the chassis members. On each end of the Rod are secured 1" Sprocket Wheels, connected by Sprocket Chain to the 2" Sprockets on the road wheel axles. It will be seen, therefore, that by sliding the Rod 8, either the travelling or tipping movement may be brought into gear. The sliding of the Rod is accomplished by a 2" Rod that engages between a ½" loose and a ½" fast Pulley, and is secured in a Coupling on a Rod 13. The Rod 13 is journalled in a 3½" Double Angle Strip bolted to the chassis, and carries on its other end another Coupling in which is held a Rod to serve as a lever. In order to manipulate the latter conveniently, a Strip 14, which projects through the slot of the 5½"×2½" Flanged Plate forming the side of the cab, is attached pivotally to it by a bolt inserted in a Collar on the upper extremity of the lever. A Spring 15 (see Fig. 2) keeps the lever normally in the travelling position, so that to engage the tipping movement it is necessary to pull out the Strip against the tension of the Spring. A similar scheme is followed in regard to the Motor control switch. In this case a 5½" Strip 16 is attached pivotally to the top end of a Crank Handle, which is secured rigidly by means of a Coupling to the motor switch arm.

The tipping body pivots about a 3½" Rod 17 that is passed through holes in two 12½" Angle Girders bolted to the underside of the body, and also through the ends of a 2½"×½" Double Angle Strip. This Double Angle Strip is secured by ⅜" Bolts to a 5½" Angle Girder spanning the end of the chassis, and is spaced therefrom by three 2½" Strips.

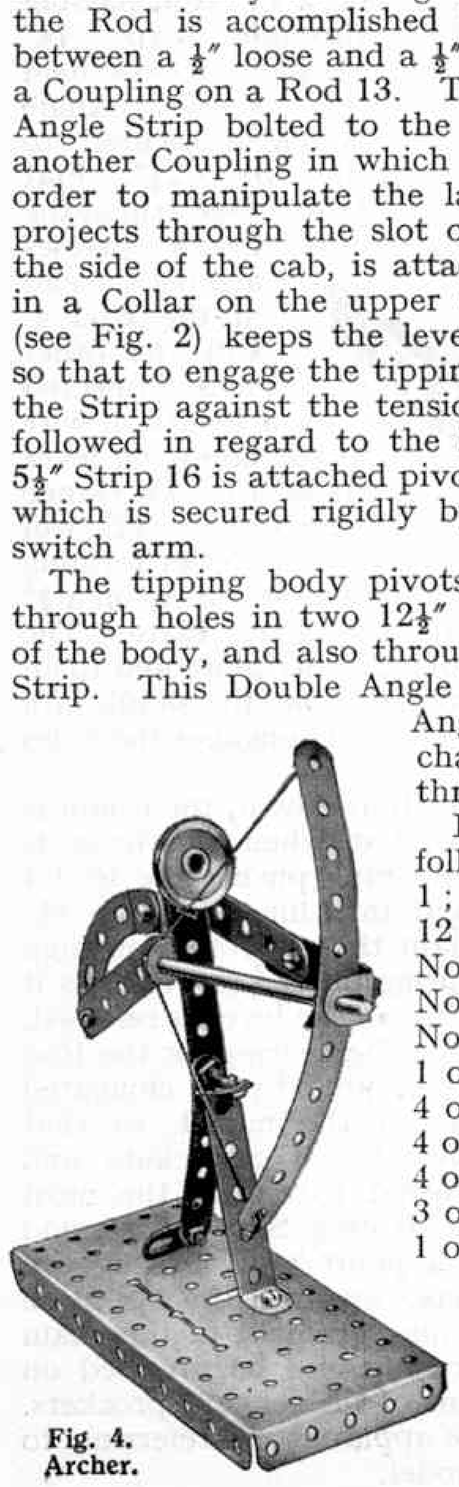


Fig. 4. Archer.

In order to build the Steam Wagon the following parts will be required: 6 of No. 1; 2 of No. 1b; 19 of No. 2; 4 of No. 2a; 12 of No. 3; 1 of No. 4; 8 of No. 5; 4 of No. 6; 4 of No. 6a; 10 of No. 8; 2 of No. 8b; 4 of No. 9; 7 of No. 10; 21 of No. 12; 4 of No. 12a; 1 of No. 13a; 1 of No. 14; 4 of No. 15; 3 of No. 15a; 4 of No. 16; 3 of No. 16a; 5 of No. 17; 4 of No. 18a; 1 of No. 19s; 2 of No. 19a; 4 of No. 19b; 1 of No. 20a; 3 of No. 20b; 3 of No. 22; 2 of No. 22a; 1 of No. 23; 1 of No. 23a; 3 of No. 26; 2 of No. 27a; 1 of No. 29; 1 of No. 32; 14 of No. 35; 164 of No. 37; 10 of No. 37a; 24 of No. 38; 1 of No. 40; 1 of No. 43; 1 of No. 48a; 1 of No. 48b; 2 of No. 48d; 4 of No. 52; 4 of No. 52a; 2 of No. 53a; 1 of No. 57; 19 of No. 59; 1 of No. 62b; 5 of No. 63; 1 of No. 70; 1 of No. 90; 24" of No. 94; 2 of No. 95; 2 of No. 96; 4 of No. 99; 4 of No. 100; 2 of No. 103f; 2 of No. 108; 1 of No. 109; 2 of No. 111; 4 of No. 111c; 2 of No. 115; 1 of No. 116a; 1 of No. 125; 4 of No. 126; 4 of No. 126a; 1 of No. 160; 1 of No. 162; 1 of No. 163; 1 of No. 164; 2 of No. 165; 1 of No. 166; 1 E6 Motor.

Fig. 3. Inverted view of the Steam Wagon showing transmission and steering gear.

The Meccano Archer

The miniature bowman shown in Fig. 4, complete with long-bow and arrow, is no doubt a highly skilled archer, although we doubt whether his efforts would rival those of William Tell!

The model is quite straightforward to build and its assembly should present no difficulty. Parts for the model are as follows: 2 of No. 2; 3 of No. 5; 1 of No. 10; 1 of No. 11; 3 of No. 12; 1 of No. 16; 1 of No. 22; 1 of No. 35; 11 of No. 37; 1 of No. 40; 1 of No. 48a; 1 of No. 52; 1 of No. 90a; 1 of No. 111c.

A Diminutive Stiff-leg Derrick

Owners of very small outfits (the 000 Outfit in particular) will be interested in the model derrick shown in Fig. 5. The construction of this model is very simple indeed, but one point that requires explanation is the method of pivoting the jib to the upright leg. A bolt is first of all placed in the end hole of the 5½" Strip that forms the jib, and a nut is screwed on to the shank of the bolt so that there is sufficient room for the Strip to pivot freely. The projecting shank of the bolt is next passed through the bottom hole of the Strip forming the upright, and through the hole in an Angle Bracket secured to the triangular base. A second nut is then placed on the shank of the bolt. The two nuts should then be rotated in opposite directions by means of two Spanners so that the Angle Bracket and upright Strip are clamped rigidly together, while the second 5½" Strip forming the jib is free to rotate.

A 1" loose Pulley is mounted on the upright Strip so that the jib suspension cord may be passed round it. The Pulley rotates on a ⅜" Bolt which is secured as follows. The Bolt is first of all passed through the centre hole in the Pulley and a nut is screwed on to the Shank so that there is sufficient room for the Pulley to rotate freely. The projecting end of the Bolt is then passed through the Strip and a second nut is screwed on to the shank of the Bolt. The two nuts are rotated in opposite directions by means of Spanners (as in the case of those holding the upright 5½" Strip in place), so that the ⅜" Bolt is locked securely to the upright Strip. A second 1" loose Pulley is mounted in an exactly similar manner at the top of the Strip forming the jib. The hoist cord is passed round this Pulley and is then wound round a 2" Axle Rod that is mounted in two Trunnions secured to the base of the crane.

This model represents perhaps the limit in simplicity of construction in a model derrick crane, and it provides a remarkable contrast with the Super Models of this type of crane, the Stiff-Leg Crane, Super Model No. 6, and the Scotch Type Electric Derrick Crane, Model No. 36. Although these models may score over our example in mechanical features and realism, the crane shown in Fig. 5 certainly possesses the advantage of a very economical "parts required" list, which is as follows:—2 of No. 2; 2 of No. 5; 3 of No. 12; 1 of No. 17; 2 of No. 22a; 1 of No. 35; 7 of No. 37; 3 of No. 37a; 1 of No. 40; 1 of No. 48; 2 of No. 111c; 2 of No. 126.

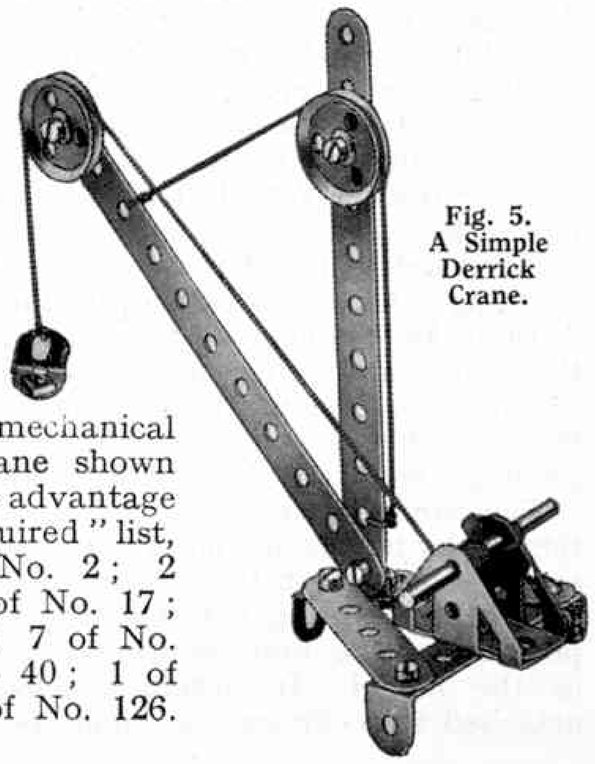


Fig. 5. A Simple Derrick Crane.

Suggestions Page

(248) Demonstration Model of Two-speed Derailleur Gear

(S. Higson, Exeter)

The usual form of gear box incorporated in bicycles is the three-speed hub built into the rear wheel and operated by a small lever attached to the top tube or handlebars. The hub contains a small planetary gear box, and by an ingenious system of pawls and ratchets, the three different speed ratios are obtained. Another form of gearing, generally a two-speed gear, is incorporated in the bottom bracket of some machines. The latest gear change device is the Derailleur system, whereby the chain is made to jump from one sprocket to another on the rear wheel. This system has been in use on the Continent for some considerable time, but is comparatively new in this country.

The chief advantage of the Derailleur over the hub gear is that practically any range of gears is obtainable, and it is possible to have a choice of as many as eight different speeds, by fitting two cogs on each side of the rear wheel, and having a double chain wheel at the bottom bracket. The rear wheel can then be reversed, or the chain moved from one driving sprocket to the other, but these operations must be carried out by hand. Three different sprockets can be fitted to the rear wheel to give a three-speed gear, the changing of the chain being controlled by a lever. Other advantages of this form of gearing are direct drive on all gears, and easy accessibility of working parts for cleaning and adjustment. The misalignment of the chain on extreme gears, although theoretically incorrect, does not interfere with the smooth working of the mechanism, and the damage done to the chain when changing gear is negligible.

The Meccano model illustrated on this page demonstrates clearly the principle of the Derailleur, and will be found suitable for incorporation in many models where a change speed gear is required. In this case two speed ratios may be obtained by changing the Sprocket Chain from one to the other of the Sprocket Wheels 1 and 2, which are mounted face to face, but spaced apart approximately $\frac{1}{8}$". The $\frac{3}{4}$" Sprocket Wheel 3 is free to rotate on the Rod 4 carrying a Crank, which forms the tensioning arm. A Pivot Bolt is held by two nuts in the end hole of the Crank, and carries a $\frac{3}{4}$" Sprocket Wheel 5. The Chain passes round the driving Sprocket 6, under the Sprocket 5, and over Sprocket 3, eventually passing round one of the wheels 1 and 2.

The Sprocket 5 keeps the chain at the correct tension by means of a length of Spring Cord attached to a $\frac{3}{8}$" bolt held in the boss of the Crank. The tension of the Spring can be varied by altering the position of the bolt securing it to the framework of the model. In actual practice the spring is attached to a clip on the chain stay of the bicycle, to which also a second clip is attached for supporting the changing mechanism. As shown in Fig. 248, the chain passes from the Sprocket 3 to the Sprocket 1, consequently these two Sprockets must be in perfect alignment. Operation of the gear-change lever causes the tensioning arm, complete with both Sprockets, to move outward, so that the Sprocket 3 is brought into line with the Sprocket 2; and as the driving Sprocket rotates, the Chain is conveyed on to the smaller driven Sprocket. The Wheel 3 is held in position on the Rod 4 by the Crank and a Collar, a washer being placed behind the Crank for spacing purposes.

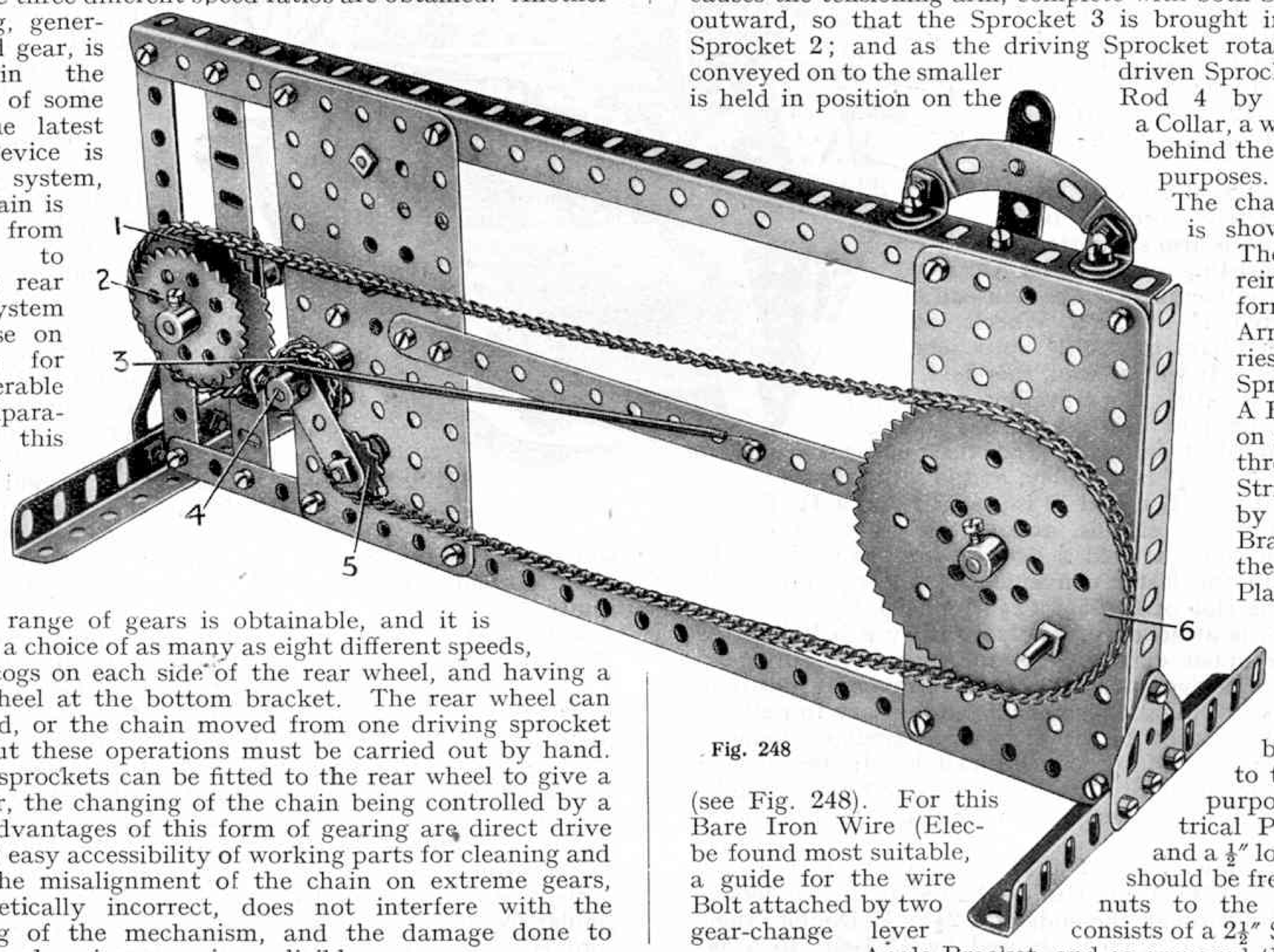


Fig. 248

The changing mechanism (see Fig. 248). For this is shown in Fig. 248a. Bare Iron Wire (Electrical Part No. 312) will be found most suitable, and a $\frac{1}{2}$" loose Pulley forming a guide for the wire should be free to rotate on a $\frac{3}{8}$" Bolt attached by two nuts to the Flat Plate. The gear-change lever consists of a $2\frac{1}{2}$" Strip pivoted to an Angle Bracket, and so arranged that the shank of a bolt near the upper end of the lever engages the holes in a $2\frac{1}{2}$" Curved Strip.

The Rod 4 is held in a reinforced bearing formed from a Double Arm Crank, and carries a Compression Spring and Collar. A Bell Crank is fitted on a $1\frac{1}{2}$" Rod passing through two $1\frac{1}{2}$" Strips that are held by $1" \times \frac{1}{2}"$ Angle Brackets secured to the $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plate. One arm of the Crank presses against the end of the Rod 4, and the other arm is connected by a length of wire to the changing lever purpose No. 27 Gauge

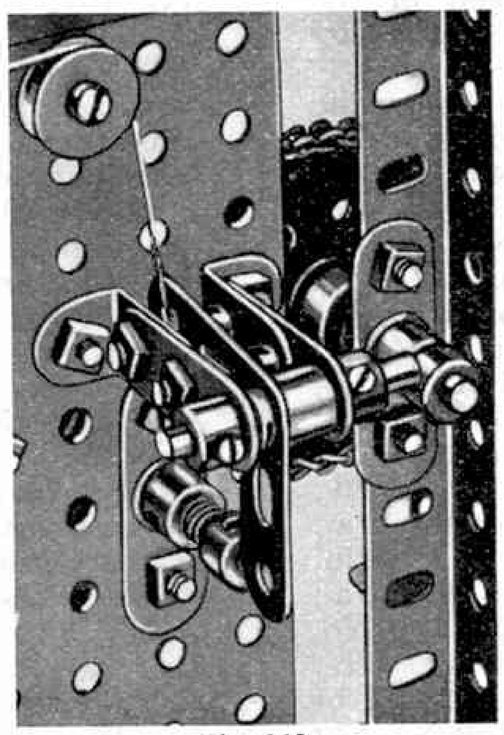


Fig. 248a

With the lever in the position shown, the Chain is fed on to the 2" Sprocket 1; but when the lever is moved to the left, the Bell Crank pushes the Rod 4 until Sprocket 3 is brought into line with the $1\frac{1}{2}$" driven Sprocket. The chain then operates on high gear. The compression Spring on the rod returns it to its former position as soon as the lever is released. The Angle Girder supporting the bearing for the Rod of the driven Sprockets is secured by its elongated holes to the outer frame of the model, so that the distance between the driven Sprockets and the Wheel 3 can be adjusted to obtain the most satisfactory results. The driving Sprocket should be directly in line with a point midway between the two driven Sprockets, and in this position it will be found that the misalignment of the chain is imperceptible. The drive cannot be reversed on account of the arrangement of the jockey sprockets. The reason for this will be apparent on referring to the general view of the model.

(249) An Ingenious Meccano Puzzle Box

Another Mystery Competition for Readers

The Meccano box illustrated in Fig. 249 is fitted with a sliding lid that is automatically locked immediately it is closed. The box cannot be reopened unless the key is known, and yet the method of opening is extremely simple. Examination of the box will show that it is built up from $4\frac{1}{2}'' \times 2\frac{1}{2}''$ and $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates, and Angle Girders, and consequently there are no hidden trap-doors concealing handles or levers by means of which the catch may be released.

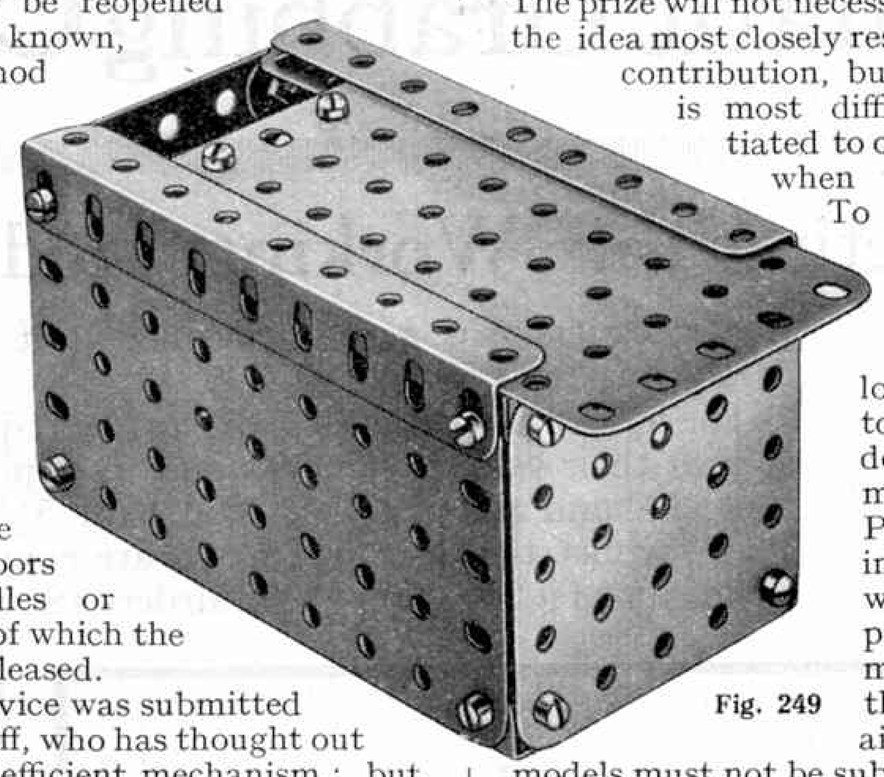


Fig. 249

The locking device was submitted by W. J. Langstaff, who has thought out a very neat and efficient mechanism; but before divulging the solution we have decided to give other readers an opportunity to exercise their skill and ingenuity in thinking out how the lock works. A prize of half a guinea will be awarded to the reader who submits the most ingenious and efficient locking mechanism that may be used in the box. A number of consolation prizes also will be awarded to the senders of other mechanisms of outstanding interest. The prize will not necessarily be awarded for the idea most closely resembling Langstaff's contribution, but for the lock that is most difficult for the uninitiated to open, and yet simple when the key is known.

To enter this contest competitors should submit clear drawings or photographs of the locking mechanism, together with a full description of the method of operation. Photographs or drawings need not be the work of the competitor, but the mechanism must be the result of his unaided efforts. Actual models must not be submitted. If required, entries will be returned to unsuccessful competitors provided that a stamped addressed envelope of the necessary size is enclosed.

Envelopes containing entries should be posted so that "Spanner" receives them not later than 30th November, 1931.

(250) Two-speed Reversing Crane Hoist

(R. Phillip, Brechin, Angus)

When a non-reversing motor is used in a model crane, the lowering of the load and the jib is generally effected by disengaging the hoisting shafts from their respective driving shafts and regulating the amount of cord paid out by means of a brake. Fig. 250 shows an ingenious device that enables the paying out and hauling in of the hoisting cord to be operated by the motor.

Two drums 2 and 3 are utilised for this purpose, and are driven by a No. E.1 Electric Motor. A 57-teeth Gear engages the Motor driving pinion, and the drive is led through Sprocket Gearing to a Rod carrying a $\frac{1}{2}''$ Pinion. The Pinion meshes with a 57-teeth Gear 1, the shaft of which also carries a $\frac{1}{2}''$ Pinion 5, and the drum 2 built up from a Sleeve Piece and two $\frac{3}{4}''$ Flanged Wheels. The Rod of the drum 3 is slidable in its bearings, and in order to allow sufficient movement of the Rod, the drum carries a $\frac{3}{4}''$ Flanged Wheel at one end only. The other end of the Sleeve Piece is passed over a Chimney Adaptor, and a 1" loose Pulley is clamped in position by the Pinion 6. The sliding movement of the Rod is controlled by the Lever 7, which is pivoted at its lower end to a $1'' \times 1''$ Angle Bracket, and loosely connected to the Rod by a $\frac{3}{8}''$ bolt, passed through its centre hole and inserted in the tapped bore of a Collar revolving idly between two fixed Collars. A nut prevents the shank of the bolt gripping the Rod.

The hoisting cord is wound round one of the drums and passed over a Pulley at the head of the crane jib, and after passing through a Single Sheave Pulley Block it returns over a second Pulley at the jib head, and is wound on to the remaining drum.

With the lever 7 in its present position the drive between the two drums passes from the Pinion 5 to the Gear 4, so that the drum 2 rotates three times as fast as the drum 3. The former should be arranged to wind in the hoisting cord and the latter to pay out. As three times the amount of cord paid out is hauled in, the load is raised. When the lever 7 is moved to the left, the Pinion 6 engages the Gear 1, and the Gear 4 is moved out of engagement with the Pinion 5. This causes the drum 3 to pay out the cord faster than it is hauled in, thus lowering the load.

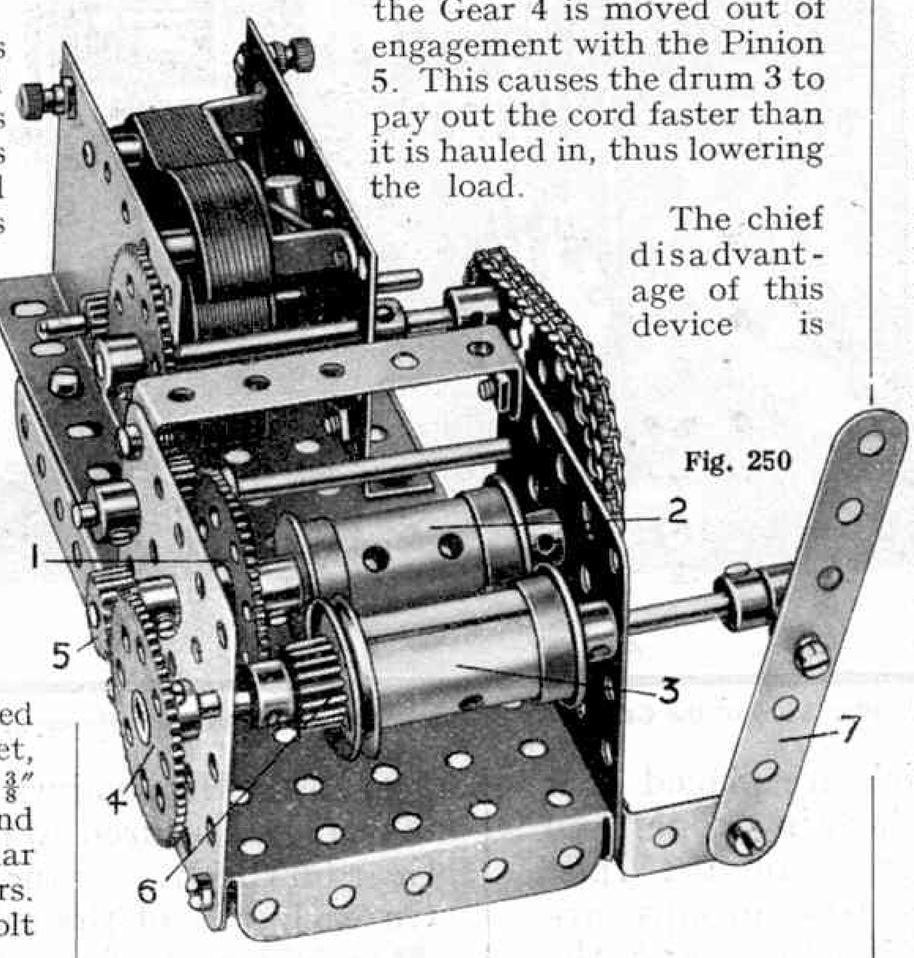


Fig. 250

The chief disadvantage of this device is that after several hoisting and lowering operations all the cord is wound on to the drum 2, and consequently some means must be devised for winding it back to drum 3. To do this without altering the position of the crane hook a 1 : 1 ratio should be inserted between the two drums. Very little power will then be required to wind the cord back again.

Miscellaneous Suggestions

Under this heading "Spanner" replies to readers who submit interesting suggestions regarding new Meccano models or movements that he is unable to deal with more fully elsewhere. On occasion he offers comments and technical criticisms that, he trusts, will be accepted in the same spirit of mutual help in which they are advanced.

(M.135). Meccano Thumbscrew.—A small thumbscrew that will be of utility in many models is suggested by J. Yates (York). A Meccano bolt of any convenient length may be used, and a washer is carefully filed to fit the slot in its head. The washer is held in place by means of solder. The finished part occupies very little more room than is taken up by an ordinary bolt, but the washer provides a firm grip that cannot be obtained with the bolt head only.

(M.136). A Neat Handrail.—Constructors who endeavour to build their models as nearly as possible to the correct scale will be aware that Meccano Axle Rods and Handrail Supports are sometimes too large to preserve the proportions of a model. C. Hackney (Shrewsbury) uses Spring Cord for this purpose, but to hold the cord in place he passes stiff wire through the centre and secures it to $\frac{3}{8}''$ Bolts attached to the model by two nuts, and forming handrail supports. By this means handrails of any shape may be made.

(M.137). Electrical Contact Breaker.—S. James (Kidderminster) informs us that gramophone needles form excellent contact breakers for Meccano electrical models. James suggests that the needle should be held in a Coupling, but such an arrangement would be clumsy, and fine adjustments could not be made. Although the device may be efficient in operation, Silver Tipped Contact Screws (Part No. 307) are more compact and allow finer adjustments.

(M.138). Winding the Clockwork Motor.—When the Clockwork Motor is used to drive a model, the model must be stopped for the Motor to be rewound. This is very often inconvenient, and in order to overcome the difficulty K. Makins (Havant, Hants.) arranges a Flywheel to be driven by the Motor through several stages of step-up gearing. The flywheel acts as a "momentum motor" when the Clockwork mechanism is rewound, and will continue to drive the model for a considerable period without much loss of speed.

(M.139). Light-weight Bicycle Carrier.—Readers who are also keen cyclists will appreciate the suggestion put forward by S. Cunliffe (Manchester) for a dual purpose touring bag support and carrier of extra light construction. Cunliffe evidently believes in keeping the weight of his machine as low as possible, and there is much to be said in favour of this when cycling long distances. The carrier is built from Meccano Axle Rods and Couplings, the whole being attached by End Bearings to two Strips that are clamped round the seat stays of the bicycle. Further support is provided by two Rods attached near the other end of the carrier and secured by similar means lower down the seat stays. On machines that are provided with special brazed-on fittings for the mudguard stays, the carrier supports may be fitted to these.

Although the carrier is very light, it is capable of supporting quite a considerable weight, and it also forms a support when a large touring-bag is slung behind the saddle. This takes some of the weight off the straps and prevents the bag from resting on the mudguard.

New Meccano Model

Level-Luffing Automatic Grabbing Crane

Instructions for Completing this Working Model

THE first part of the construction of the Automatic Grabbing Crane was dealt with fully last month, and now we conclude the detailed instructions by describing the special Grab and the arrangement of the necessary electrical equipment, which includes the electric controller that enables six different speeds to be obtained from the Motor. In addition, full instructions are given for the final assembly of the various parts. Last month's article concluded with a description of the jib, and it now remains to assemble the jib-head pulleys before going on to the construction of the gear box.

The jib head has two distinct sets of pulleys. One set is at the extreme end of the jib and consists of a $1\frac{1}{2}$" Pulley secured to a Rod that has a 1" fast Pulley mounted loosely on each extremity. The other set comprises three pairs of Pulleys on a common Rod. The centre pair consists of two 1" loose Pulleys, on each side of which are placed Flat Trunnions to act as guards for the hoisting rope, and each of the two remaining sets consists of a 1" fast and a 1" loose Pulley. The respective groups are spaced on the Rod by Collars and Washers, and the bosses of the fast Pulleys serve to keep the Pulleys away from the supporting frame, so that all may run freely.

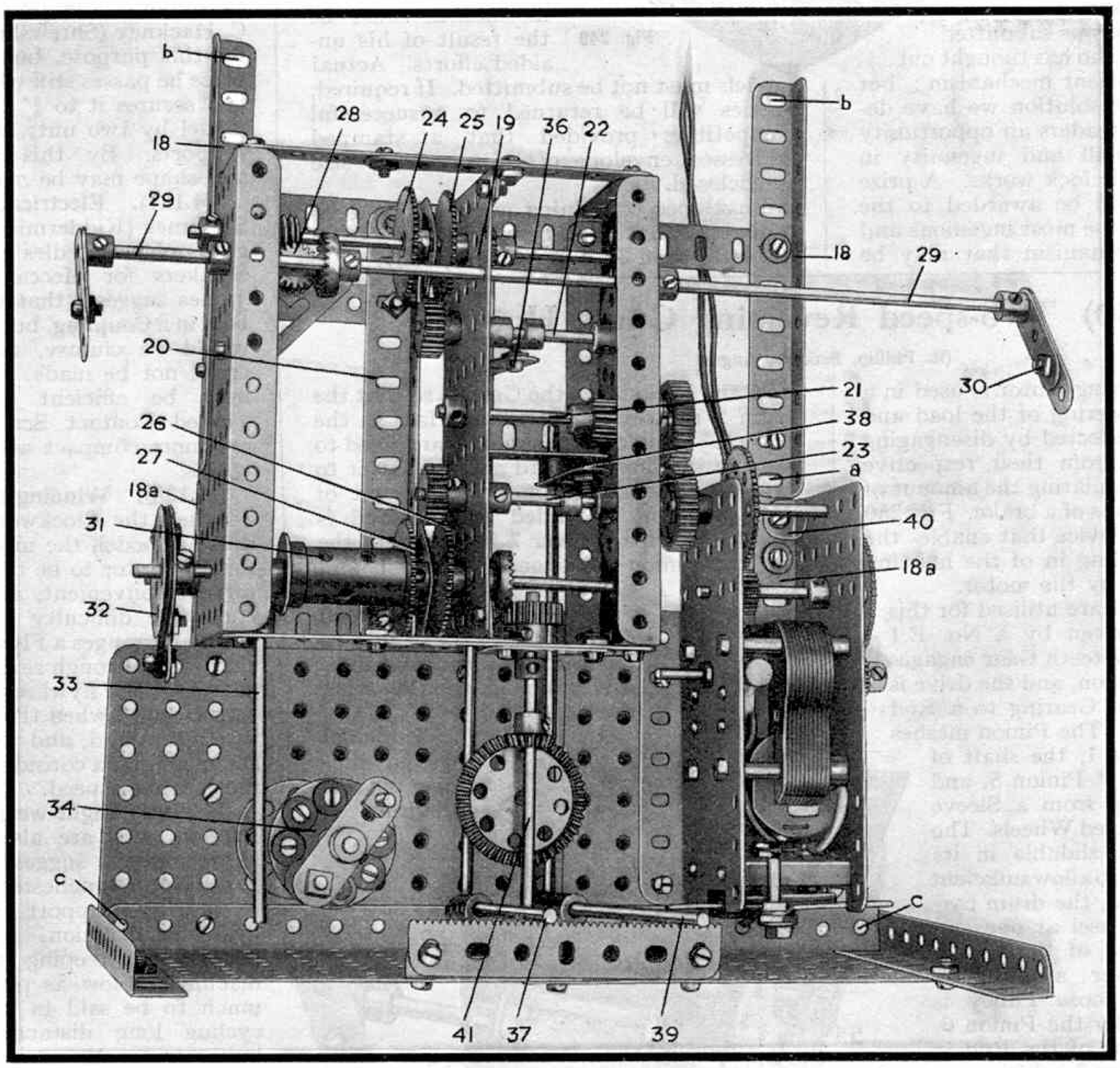


Fig. 4. Plan View of the Gear Box. Its simplicity of design is clearly apparent.

The gear box (Fig. 4) enables the four movements of hoisting, slewing, travelling and luffing to be driven from the 6-volt Meccano Electric Motor merely by the operation of two levers. A point worthy of note is the fact that it forms a self-contained unit that is readily fitted into the model.

The $5\frac{1}{2}$" Angle Girders 18, 18a, are butt-jointed together so that their vertical flanges point in opposite directions, the left-hand pair being bolted to a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate, whilst the right-hand pair are connected together by means of a 2" Strip. The Girders 18a also are secured at right-angles to, and two holes from either end of, a $9\frac{1}{2}$" Angle Girder that will eventually be secured to the ends of the Girders 11 (see Fig. 1, Sept. "*M.M.*)." Cross Girders, each $7\frac{1}{2}$" long, are bolted across the Girders 18, 18a, to carry the centre Plate 19 and the right-hand Plate of the gear box, and a $5\frac{1}{2}$" Angle Girder 20. The centre plate 19 is a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plate and it is secured to the cross Girders by a $5\frac{1}{2}$" Angle Girder.

Having now completed the constructional part of the gear box, we may turn our attention to the gearing. The mainshaft 21, which is driven by the Motor, has secured to it a 1" Gear in mesh with a similar Gear on the Motor, and also a $\frac{1}{2}$" diameter $\frac{1}{2}$" wide Pinion. On each side of the mainshaft are two sliding layshafts 22 and 23, each of which carries a $\frac{3}{4}$" Pinion and a 57-teeth Gear, the latter being in constant mesh with the $\frac{1}{2}$" wide Pinion on the mainshaft.

The layshaft 22 is moved in its bearings by the Crank 36, which is secured on an 8" Rod that carries the lever 37. The layshaft 23 is actuated in a similar manner by the lever 39 through the medium of the Crank 38. Both Cranks carry bolts, the shanks of which locate

between Collars spaced a short distance apart on the Rods.

By sliding the layshaft 23 to the right the $\frac{3}{4}$" Pinion is brought into engagement with a 50-teeth Gear 26. This Gear is secured to a Rod carrying a $\frac{3}{4}$" Contrate that is in mesh with a $\frac{3}{4}$" Pinion on a Rod 41. The latter is journalled in a Flat Trunnion that is bolted to the front top edge of the gear box and also in one of the $5\frac{1}{2}$" × $3\frac{1}{2}$" Flat Plates forming the front of the cabin. It has secured to it a $\frac{1}{2}$" Bevel, and this meshes with a $1\frac{1}{2}$" Bevel on a short vertical Rod on the lower extremity of which is fixed the Pinion 35 that meshes with the teeth of the fixed slewing Race 8 (see Fig. 2, Sept. "*M.M.*"). When the Pinion 35 rotates, it runs round the circumference of the Race and thus causes the model to slew.

A reinforced bearing is provided for the Rod carrying the Bevel and the Pinion 35 by bolting a $7\frac{1}{2}$" Girder across the Girders 18a beneath the floor plates. The Rod also passes through the end hole of a Strip that is bolted to the upper member of the slewing race.

On moving the layshaft 23 to the left the $\frac{3}{4}$" Pinion is brought into mesh with a 50-teeth Gear 27 on the hoisting barrel shaft. The hoisting barrel 31 consists of a Sleeve Piece, one end of which is passed over a $\frac{1}{2}$" fast Pulley secured against the face of the 50-teeth Gear, and it is held firmly in place by means of a $\frac{3}{4}$" Flanged Wheel that is pushed on to its other end.

The hoisting barrel is fitted with a novel automatic servo brake that allows the load to be hoisted with perfect freedom, but applies the brake when the barrel tends to unwind. An unequal-armed crank, composed of a 2" Strip bolted to a Double Arm Crank, is fitted on the end of a Rod that is journalled in the gear box sideplate and in the $5\frac{1}{2}$" Angle Girder 20. The Rod may be operated by the lever 33 that is secured to it by a Coupling; by raising the lever the brake is released. A short length of cord is passed round the brake drum 32 and its ends tied to the shanks of bolts on the extremities of the crank. The automatic servo effect is accounted for by the fact that the points of attachment of the brake band to the crank are at different distances from the fulcrum.

A 50-teeth Gear 25 is secured to a Rod that also carries a $\frac{1}{2}$" Pinion. The latter will mesh eventually (when the gear box is mounted in place) with a $1\frac{1}{2}$" Contrate on the upper end of the Rod 9 (see Fig. 1, Sept. "*M.M.*"). In this manner the drive will be transmitted from the gear box to the wheels.

The last movement to be considered is that of luffing the jib. The luffing cranks 30 are secured on the extremities of an $11\frac{1}{2}$" Rod 29, which has secured to it a $\frac{3}{4}$" Contrate that meshes with a $\frac{1}{2}$" Pinion 28 on a short vertical Rod. The latter has a further $\frac{1}{2}$" Pinion that meshes with a Worm on the Rod carrying the 50-teeth Gear 24. The Rod with the Pinion 28 is journalled at its bottom end in a Strip, and at its upper end in a Corner Bracket that is attached to the Flanged Plate by a $1\frac{1}{2}$" Angle Girder. One of the bolts that serve to secure the $1\frac{1}{2}$" Angle Girder to the Plate is also passed through a $2\frac{1}{2}$" Angle Girder, which is bolted vertically to the Plate for strengthening purposes.

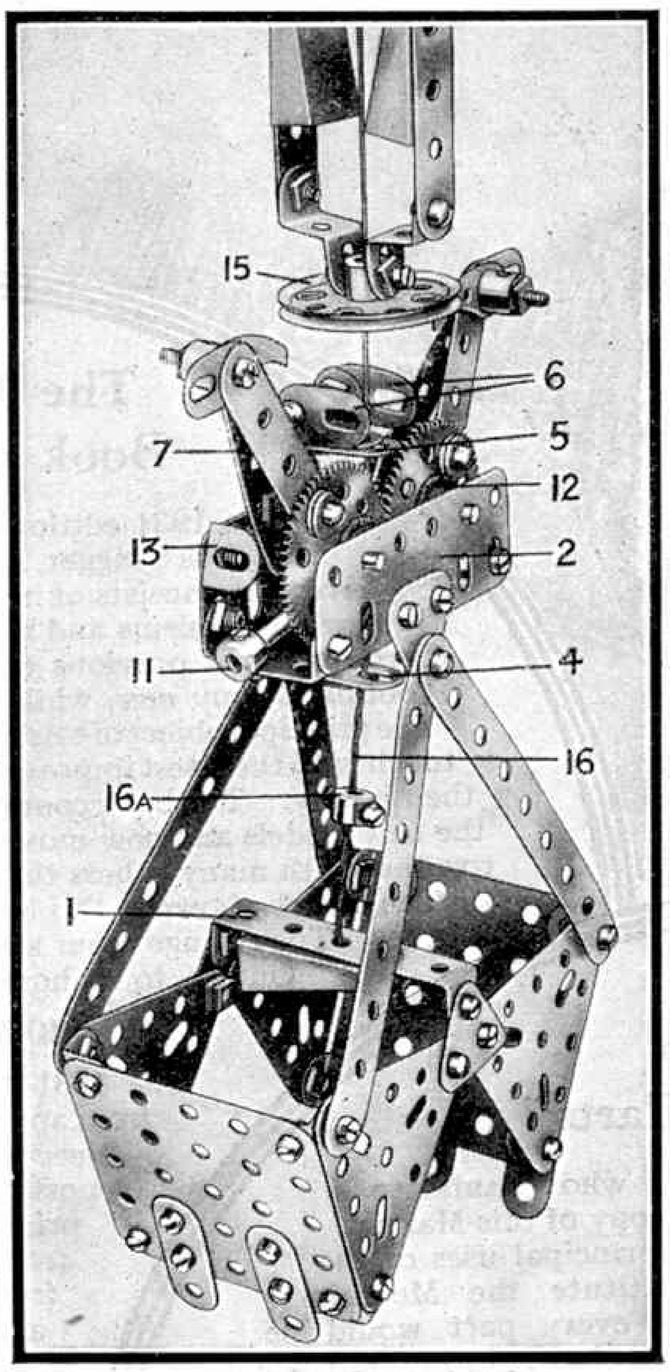


Fig. 5. The Single Suspension Grab.

There are only two items of electrical equipment that claim attention; the Motor and its gearing, and the built-up controller, which enables six different speeds to be obtained from the Motor.

The Motor is secured to the floor plates in the position indicated in Fig. 4, by nuts and bolts and by a $\frac{1}{2}$" × $\frac{1}{2}$" Angle Bracket 40. A gear train providing a reduction ratio of 9 : 1 and consisting of two $\frac{1}{2}$" Pinions and two 57-teeth Gears is employed to transmit the drive from the armature spindle to the Rod carrying the 1" Gear.

The controller is shown at 34 and is conveniently placed in relation to the other controls; it is of exceptional interest as it is built up entirely from standard Meccano parts. Space precludes anything but a brief description of the device, but readers who require fuller information on the point should refer to detail No. 115 in the Standard Mechanisms Manual.

The resistance is formed from a short length of Spring Cord, drawn out so that no two adjacent turns touch, and attached to the shanks of 6 B.A. Bolts that are insulated from the Bush Wheel on which they are mounted by Insulating Bushes and Washers. A seventh insulated stud is provided; it is not connected in any way, since it forms the "off" position of the controller. The switch arm is a Double Arm Crank, on one end of which is mounted a Spring Buffer that makes contact with the studs. The Bush Wheel is mounted on a Rod, the upper extremity of which forms a pivot for the Double Arm Crank, its lower end being secured in the boss of a Bush Wheel that is bolted to the floor.

A length of insulated wire is taken from one Motor terminal to one end of the resistance, and the other terminal of the Motor is connected to one terminal of the Accumulator. The remaining terminal of the latter is "earthed," that is, connected to the frame of the model. If coloured parts are used, it may be found necessary to remove the enamel from beneath the bolt holding the earth wire to the frame and also beneath the bolts securing the controller to the floor plates.

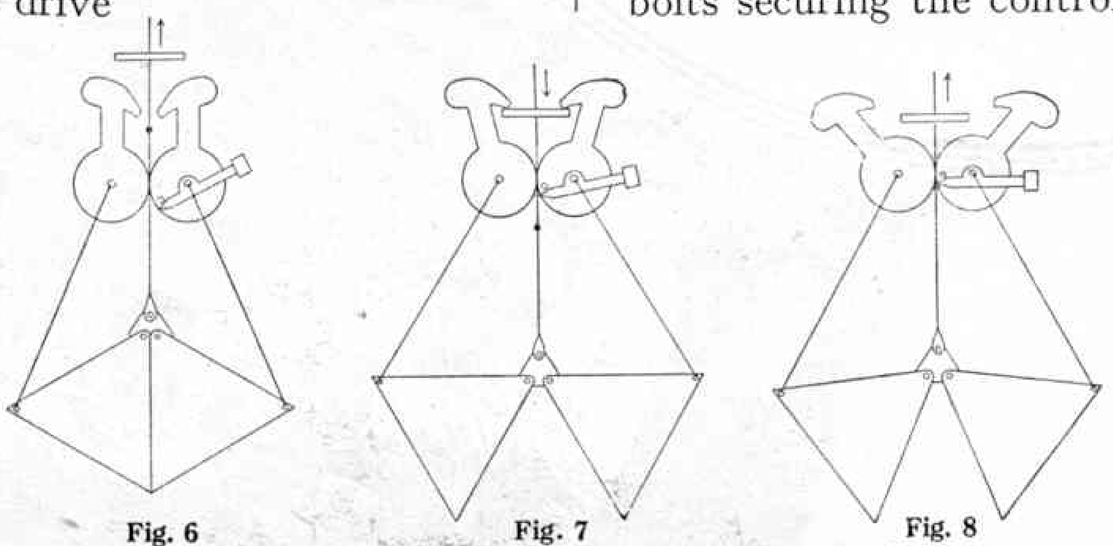


Fig. 6 Fig. 7 Fig. 8

Diagrams illustrating operation of Single Suspension Grab.

We now come to the most interesting stage of the construction, that of fitting together the various units to form the complete model. The gear box unit should be first fixed into position on the Girders 11 and 12 and between the Girders 13. This is accomplished by arranging the holes a, b, c (Fig. 4) of the gear box to coincide with similar indexed holes on the

1931

Two Books for every keen Meccano Model-builder

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SOUTH AFRICA : Arthur E. Harris, 142, Market Street, Johannesburg (P.O. Box 1199).

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Girders 11 and 12 (Fig. 1, Sept. "*M.M.*"). Bolts should then be inserted in these holes. It will be necessary to remove the Rod 29 (Fig. 4) temporarily before sliding the gear box into place.

The superstructure is now lowered on to the ¾" Flanged Wheels of the Ring Frame. The Rod 9 (Fig. 1, Sept. "*M.M.*") passes freely through both Races, of course, and has secured to its upper end the 1½" Contrate that meshes with the ½" Pinion on the shaft carrying the Gear 25 (Fig. 4). The upper Race should bed down quite evenly on the ¾" Flanged Wheels and the complete superstructure should turn at a touch. The Pinion 35 (see Fig. 2, Sept. "*M.M.*") must also be arranged to mesh with the teeth of the lower Race.

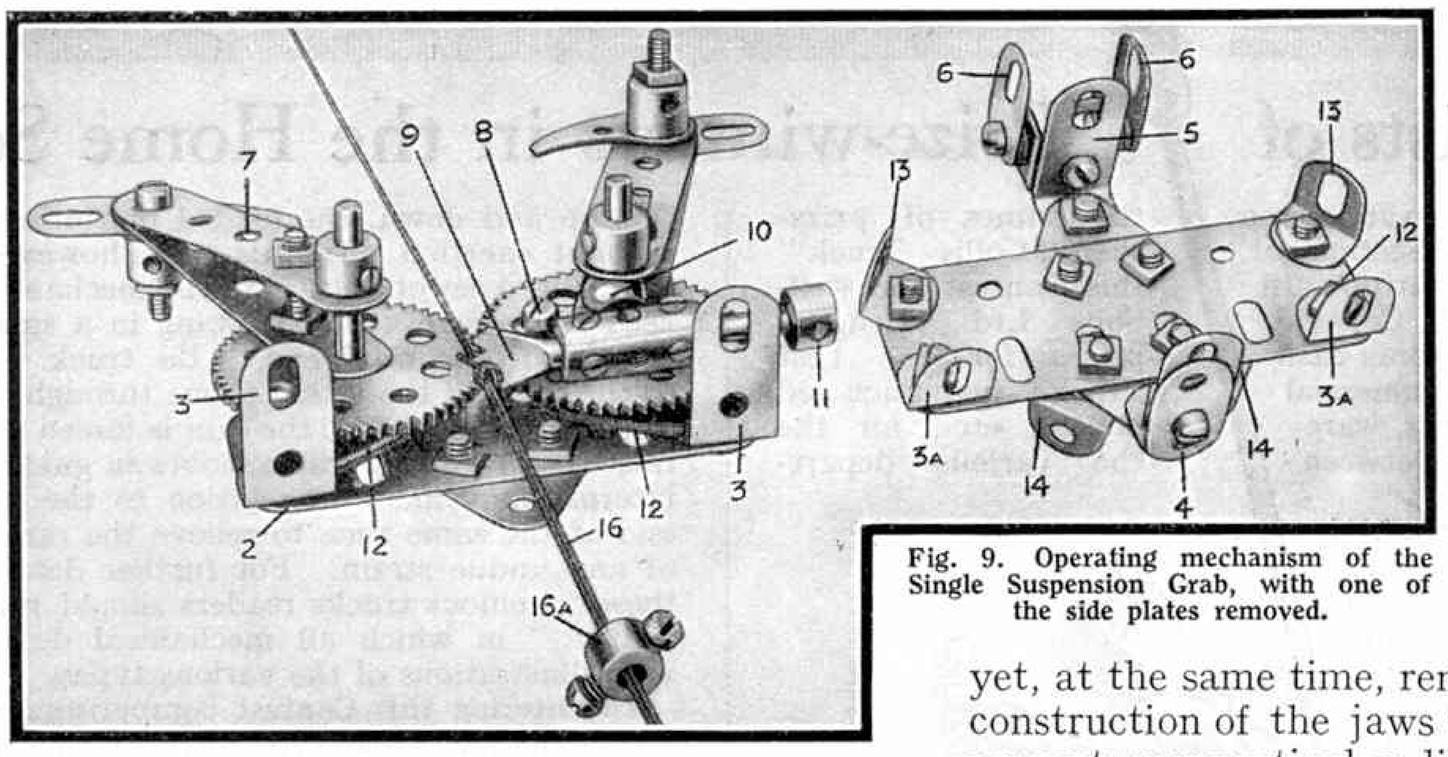


Fig. 9. Operating mechanism of the Single Suspension Grab, with one of the side plates removed.

The jib is mounted pivotally on the front of the tower by passing the 11½" Rod 14a through the Flat Trunnions 14 and through the bosses of Cranks that are secured to the sides of the jib. It is now necessary to add weights at 61 in the shape of pieces of scrap lead melted into blocks of the required shape, or large quantities of Meccano parts, until the jib is accurately balanced. The connecting rods 30a may then be attached pivotally by lock-nutted bolts to the luffing cranks 30.

The hoisting cord is attached to the hoisting barrel 31 (Fig. 4), and is led over one of the pulleys 16 at the superstructure head, passing through a guide pulley on its way (see general view of the model in the Sept. "*M.M.*"). The guide pulley consists of a 1" loose Pulley running between two Bush Wheels mounted on an 8" Rod that is secured by Handrail Supports to the tower. From Pulley 16, the cord passes over one of the centre pair of pulleys at the jib head, back over the remaining Pulley 16 and thence to the other centre Pulley on the jib head, after which it runs over the 1½" Pulley at the extremity of the jib and so down to the load hook or grab, to which it is secured.

In order to make matters quite clear to the reader we show in Fig. 10 a line drawing of the layout of the "Toplis" gear. The hoisting rope passes up from the hoist barrel to a pulley in the superstructure head B. From here it passes round one of the pulleys at the jib head A, back round the remaining pulley at B, and lastly over the second pulley at A, and so down to the load.

Now the point B is such a distance above the jib pivot that when the jib head A rises through, say, 3", the distance AB decreases by 1". Owing to the fact, however, that there are three falls of the hoisting rope passing between A and B, the shortening of the distance AB by 1" means that the end of the rope to which the hook is attached is paid out 3". Hence the load remains level throughout the entire luffing range.

Although the model may be used as an ordinary crane by fastening a Loaded Hook to the end of the hoisting cord, its interest is vastly increased by the addition of a grab.

The grab employed on the model is known as the single suspension type, and is opened and closed merely by manipulation of the hauling rope, instead of depending for its operation, as is quite usual, upon two distinct falls of rope wound on separate barrels. An excellent example of a grab of the latter type is afforded by the Meccano High Speed Ship Coaler (see Instruction Leaflet No. 2).

Fig. 5 is a general view of the single suspension grab, whilst Fig. 9 shows the grab head partly dismantled. From the latter view it will be seen that the mechanism of the grab is ingenious, yet, at the same time, remarkably simple. The construction of the jaws themselves should not present any particular difficulty since they are fairly apparent from the illustration. The apices of the Triangular Plates forming the sides of the jaws are attached pivotally by lock-nutted bolts (see Standard Mechanisms No. 263) to 1" Triangular Plates that are bolted rigidly to each end of a 2½" × ½" Double Angle Strip 1, and four connecting links (4½" Strips) are attached pivotally to the outer ends of the jaws by lock-nutted bolts. The Double Angle Strip 1 is weighted by the addition of a number of 2" Strips or a 50-gramme weight, to make the jaws open.

The side plates 2 (Fig. 9) carrying the operating mechanism are 3" Flat Girders, which are connected together by 1" × ½" and ½" × ½" Angle Brackets 3, 3a. On the side plate shown detached are fixed two 1" Triangular Plates that carry 1" × ½" Angle Brackets 4 and 5, and to the Bracket 5 is secured a Double Bracket, with two Flat Brackets 6 bolted to it. Two Washers are placed between each Flat Bracket and the Double Bracket for spacing purposes.

The hooks 7 are composed of 2½" Strips bent to the shape shown in the illustrations and attached by means of ½" Bolts to 57-teeth Gears. The ends of the Strips are each fitted with a Pawl and a Flat Bracket. The catch 9 is composed of a Centre Fork held in the end bore of a Coupling, which also carries a Handrail Support 10 and a balance weight 11 consisting of a 1" Rod to the end of which is secured a Collar. The Gears are arranged to mesh with each other so that the Hooks 7 lie at the same angle to the perpendicular, and the Rods on which they are secured should be perfectly free to turn in the side plates 2.

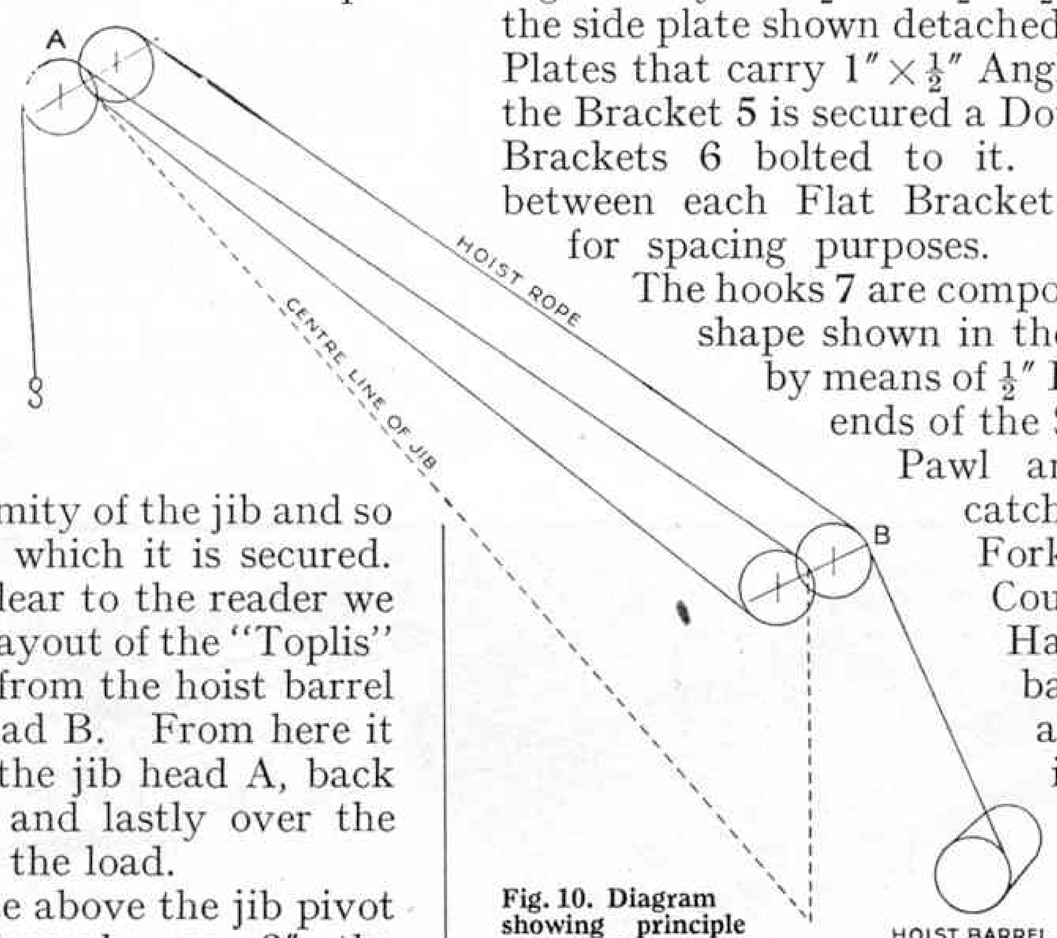


Fig. 10. Diagram showing principle of Toplis Level-Luffing Gear.

The Handrail Support 10 of the catch is mounted freely on the spindle of the right-hand Gear, and a ⅜" Bolt 8 is secured by double nuts to the Gear in the third hole from that in which the 2½"

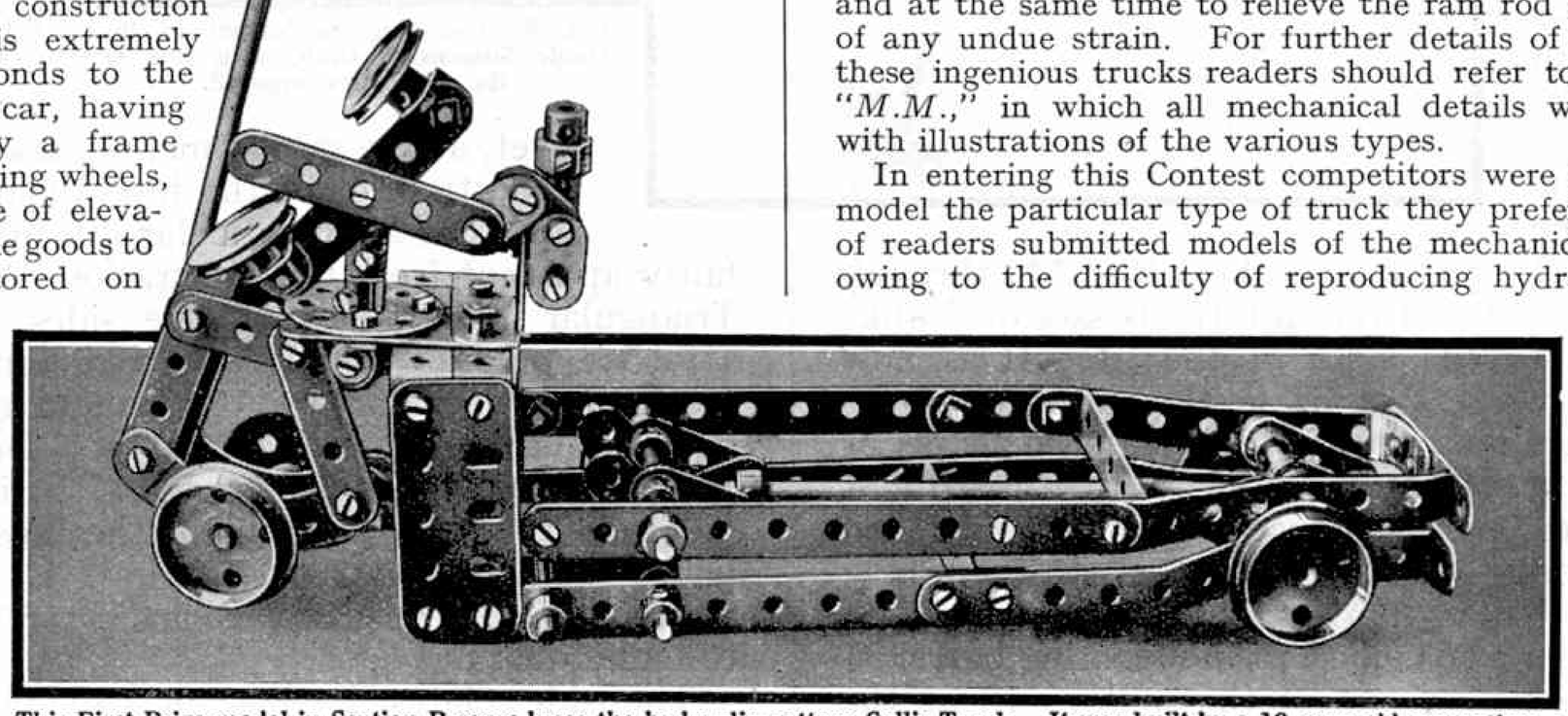
(*Continued on page 851*)

Results of the "Collis Truck" Model-Building Contest

Lists of Prize-winners in the Home Sections

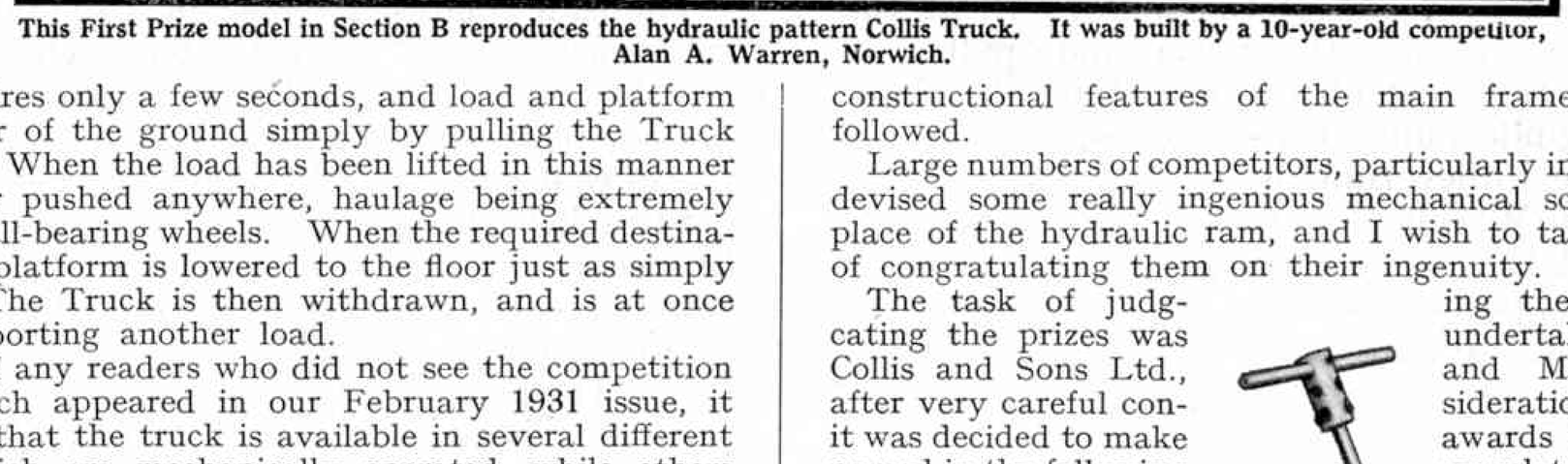
THIS month we are able to announce the names of prize-winners in the Home Sections of the "Collis Truck" Model-building Competition. In this Contest the well-known British firm of J. Collis & Sons Ltd., London, offered a number of handsome cash prizes for the best Meccano models of their commercial Trucks, manufactured for use in engineering works, warehouses, etc., for the rapid transport of goods between the various departments.

In operation and construction the Collis Truck is extremely simple. It corresponds to the chassis of a motor car, having no body, but only a frame running on ball-bearing wheels, and a compact type of elevating mechanism. The goods to be moved are stored on wooden platforms fitted with runners or skids, which raise the platform from the ground sufficiently high to allow a Collis Truck to be run underneath. When it is desired to move a load, the Collis Truck is run underneath the platform, an operation that requires only a few seconds, and load and platform are then lifted clear of the ground simply by pulling the Truck handle downward. When the load has been lifted in this manner it can be pulled or pushed anywhere, haulage being extremely easy owing to the ball-bearing wheels. When the required destination is reached the platform is lowered to the floor just as simply as it was raised. The Truck is then withdrawn, and is at once available for transporting another load.



This First Prize model in Section B reproduces the hydraulic pattern Collis Truck. It was built by a 10-year-old competitor, Alan A. Warren, Norwich.

For the benefit of any readers who did not see the competition announcement, which appeared in our February 1931 issue, it may be mentioned that the truck is available in several different types, some of which are mechanically operated, while others are operated and controlled hydraulically. The mechanical type truck is steered by means of an upright rigid handle placed in front, which can be brought to an inclined position by releasing a catch operated from a convenient point on the handle. When the handle is pulled down, the frame on which the load is carried is pulled forward and upward by means of links pivoting on the wheel axles. This action raises the loaded platform from the ground, so that it may then be transported.



This model won Second Prize in Section A, for V. C. Kaile. The hydraulic action is obtained by a Pawl and Ratchet mechanism, part of which can be seen near the foot of the steering handle.

The hydraulic Collis Trucks are designed for dealing with very heavy loads, and are operated by a special kind of hydraulic mechanism in which oil is used as the working medium. These trucks also are provided with a steering handle, and by moving this up and down, the loaded platform is lifted quite easily and without exertion. In this case, however, instead of the handle operating a set of links as in the mechanical truck, its movement is used to operate a ram working in a small oil-filled cylinder that is fitted to the front end of the truck. The ram rod is attached to the front of the lifting frame through an ingenious arrangement of toggle links, and as the ram is forced upward the lifting frame is raised. The lifting frame moves in guides in order to prevent any internal movement in relation to the main frame of the truck, and at the same time to relieve the ram rod and the lifting links of any undue strain. For further details of the construction of these ingenious trucks readers should refer to the February 1931 "*M.M.*," in which all mechanical details were given, together with illustrations of the various types.

In entering this Contest competitors were left entirely free to model the particular type of truck they preferred. The majority of readers submitted models of the mechanical trucks, probably owing to the difficulty of reproducing hydraulic mechanism in Meccano, although it was mentioned in the Competition announcement that competitors who decided to model the hydraulic trucks would be allowed to devise their own mechanical method of raising the load, so long as the constructional features of the main framework were closely followed.

Large numbers of competitors, particularly in the Home Sections, devised some really ingenious mechanical schemes to take the place of the hydraulic ram, and I wish to take this opportunity of congratulating them on their ingenuity.

The task of judging the entries and allocating the prizes was undertaken jointly by J. Collis and Sons Ltd., and Meccano Ltd., and after very careful consideration of each model it was decided to make awards to the competitors named in the following complete lists.

Section A (for competitors over 14 years living in the British Isles):

FIRST PRIZE, Cheque for £3-3s.: E. Bradshaw, Sheffield. SECOND PRIZE, Cheque for £2-2s.: V. Kaile, Mayford, near Woking. THIRD PRIZE, Cheque for £1-1s.: D. Norton, Streetly, near Birmingham.

SIX PRIZES, each of a Cheque for 10/6: C. E. Wrayford, Moretonhampstead, Devon; E. Lewis, Winchcombe, near Cheltenham, Glos.; J. Bompas Smith, West Didsbury, Manchester; H. Bentley, Low Spennymoor, Co. Durham; J. Broadhurst, Westcross, Glam.; F. Cocks Golders Green, London, N.W.11.

TWELVE PRIZES of "*Famous Trains*" by C. J. Allen: D. Jones, Llandudno; N. Hopkins, Newcastle; W. Ridgeway, Leeds; H. Tweedy, Hertford; W. Williams, Winchester; C. Ree, Cardiff; G. S. Marsh, Blackpool; K. Harland, Leigh-on-Sea; J. Huson, Upper Norwood, London, S.E.10; A. Farr, Raveningham W, Aldridge, Addington; N. Hulbert, Trowbridge.

Section B (for competitors under 14 years living in the British Isles):

FIRST PRIZE, Cheque for £3-3s.: A. Warren, Norwich, Norfolk. SECOND PRIZE, Cheque for £2-2s.: G. Thomson, Edinburgh. THIRD PRIZE, Cheque for £1-1s.: G. Seiflow, Pinner, Middlesex.

SIX PRIZES, each of a cheque for 10/6: J. Waller, Holloway, London, N.7; M. Bonthron, Golders Green, London, N.W.11; M. Orde, Oxted, Surrey; R. Gliddon, Sidmouth, Devon; R. Passmore, Sidmouth, Devon; A. LeClaire, Worksop.

In addition prizes of "*Famous Trains*" also have been awarded in this Section.

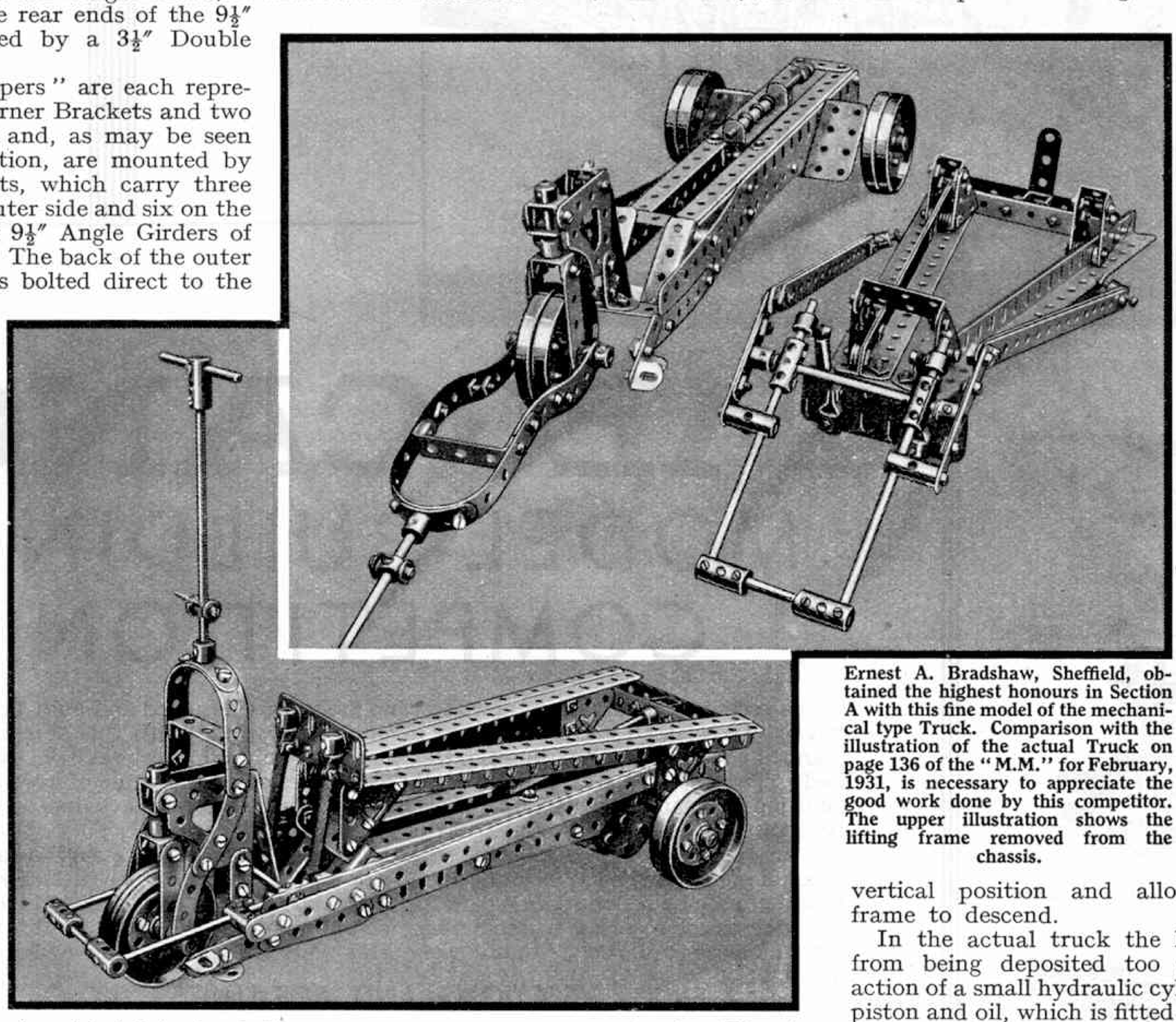
A fine model of the "R" type Truck won a cheque for £3-3s. for Ernest H. Bradshaw, Sheffield. The model is illustrated on this page, and it will be seen from the general view, and the view showing the principal parts disassembled, that Bradshaw has built a very excellent model. Not only is it strikingly realistic in appearance, but also it impresses one with its solid and workmanlike construction.

The lifting frame is constructed from 9½" Angle Girders bolted at the front end to a 2" Angle Girder, to which also is fastened a 3" Flat Girder. The rear ends of the 9½" Girders are joined by a 3½" Double Angle Strip.

The rear "slippers" are each represented by two Corner Brackets and two Double Brackets and, as may be seen from the illustration, are mounted by means of ¾" Bolts, which carry three Washers on the outer side and six on the inner side of the 9½" Angle Girders of the lifting frame. The back of the outer Corner Bracket is bolted direct to the Girders by an ordinary nut and bolt.

The front "slipper" is built from two Corner Brackets and two 1½" Double Angle Strips as shown, and is spaced at the front by Washers on ⅜" Bolts. The back ends of the Corner Brackets are bolted direct.

The links are pivotally connected to the rear "slippers" by ¾" Bolts and nuts, the Bolts being kept in position by Collars. The links are then connected to the knuckle-joints by bolts.



Ernest A. Bradshaw, Sheffield, obtained the highest honours in Section A with this fine model of the mechanical type Truck. Comparison with the illustration of the actual Truck on page 136 of the "M.M." for February, 1931, is necessary to appreciate the good work done by this competitor. The upper illustration shows the lifting frame removed from the chassis.

A 2" Strip, which may be seen at the back of the lifting frame, acts as a guide and keeps the frame central to the chassis during lifting operations.

A glance at the photograph showing the model in section will reveal the neat check-release device that prevents the load from descending too rapidly when the platform is lowered. The check-release is mounted at the rear of the chassis, and its details are clearly shown in the illustration, as also are the constructional details of the toggle yoke and steering handle. This is undoubtedly a very fine piece of work and brings great credit to its builder.

Victor C. Kaile was presented with Second Prize for a model of the hydraulic type truck.

In the case of the hydraulically-operated Collis Trucks it is of course impossible to reproduce the actual hydraulic mechanism. Competitors who chose this type of Truck had only to reproduce the construction of the framework, and then devise some mechanical means of lifting the load platform. The method employed by Kaile is as follows. When the steering handle is drawn upward, a Pawl turns a ¾" Pinion that is loose on the front axle. A short length of cord is tied to a 1" Threaded Rod that forms part of the front of the lifting frame, as shown in the photographs, and the other end of the cord is connected to the set-screw of the Pinion. Consequently, when the steering handle is lifted, the Pawl rotates the Pinion, which in turn winds up the cord and opens out the front pairs of toggle links, so causing the frame to rise. Two upward movements only of the handle are sufficient to raise the load platform to its full height. The handle is prevented from falling to the ground when the truck is stationary by means of a Compression Spring.

David Norton, winner of Third Prize in Section A, also chose the mechanical truck as the subject of his model, which is so well constructed and designed that it will carry out all the movements of the actual truck.

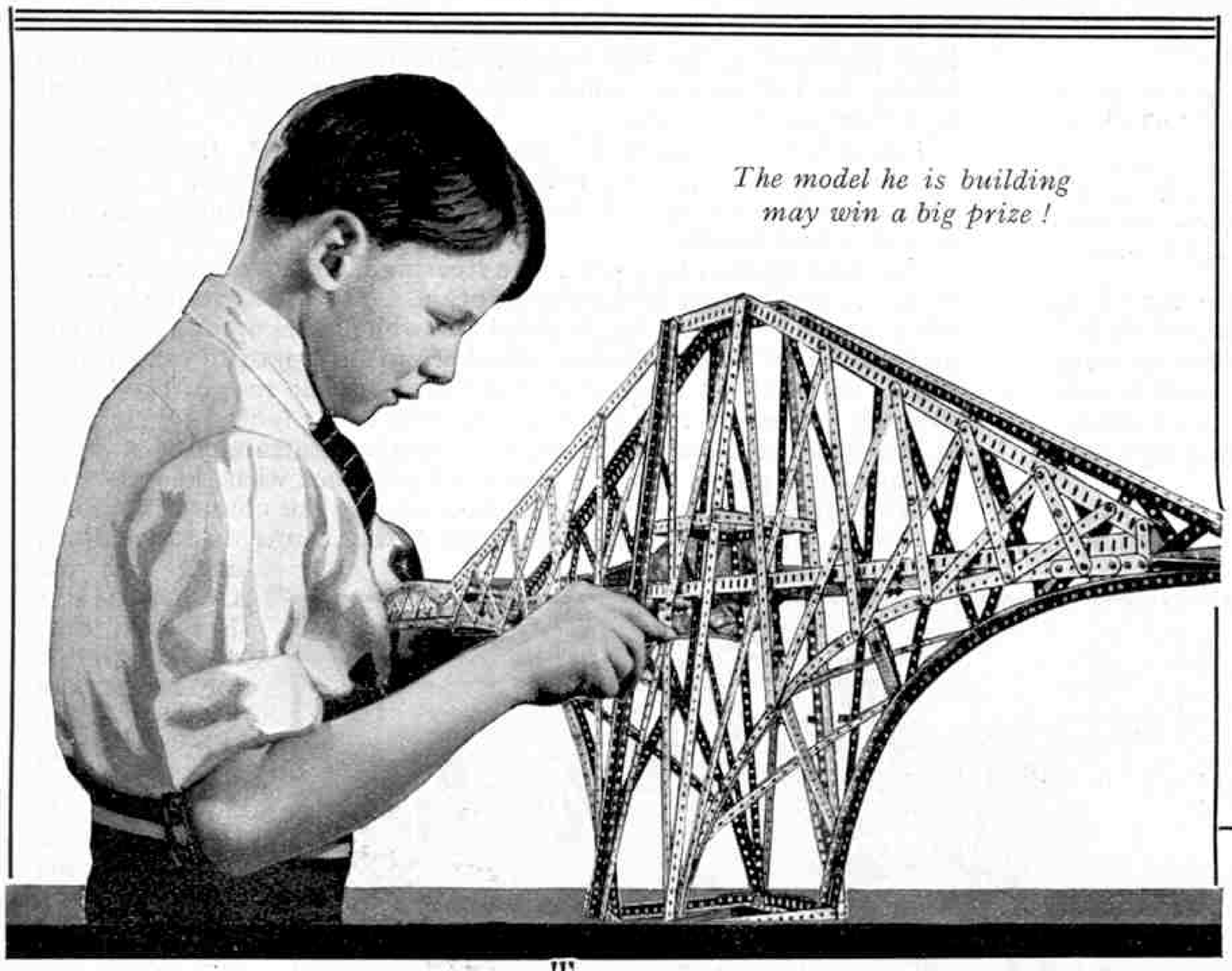
The load is lifted by pulling the steering handle from its normally vertical position to a horizontal position. The lifting frame is fitted with three 1½" Double Angle Brackets, which slide up and down the inclined edges of two Corner Brackets fitted opposite each other, one at each side of the rear of the chassis. The rear of the lifting frame is joined by long Rods to the foot of a pivoted toggle yoke at the front of the chassis, and the yoke is so arranged that when the handle is pulled down it comes into contact with the yoke and forces it downward. This operation moves the connecting Rods backward, and these in turn push the lifting frame up the inclined edges of the Corner Brackets, thus raising the lifting frame and its load. When the steering handle is pulled down to its lowest point the Rods come into line with the centre of the pivot of the toggle yoke. In this position, therefore, the lifting frame is locked, and in order to lower it the Rods must be thrown out of line with the toggle pivot. This is brought about by depressing a foot pedal that bears on one of the connecting Rods and forces it downward, thus causing the toggle to return to the vertical position and allowing the lifting frame to descend.

In the actual truck the load is prevented from being deposited too suddenly by the action of a small hydraulic cylinder containing a piston and oil, which is fitted to the body of the truck. The piston is connected to the underside of the lifting frame, so that as the load is lowered the piston is forced down on the oil in the cylinder. The oil is allowed to pass slowly from beneath the piston through a small clack valve in the piston head. It is of course impossible to reproduce this mechanism so that it will function, but Norton has copied the actual gear as closely as was possible, and in a very effective manner. The cylinder is a Sleeve Piece and a Chimney Adaptor serves for the piston.

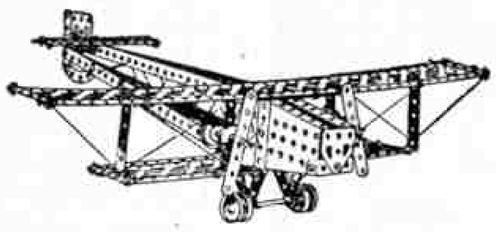
The rear wheels of the chassis are free on their axles, in order to permit differential motion and allow easy manipulation of the truck in confined spaces.

Norton not only built a good model truck, but he also went to considerable trouble in constructing a special type of side-tipping load platform or carrier, for use in transporting sand and similar materials.

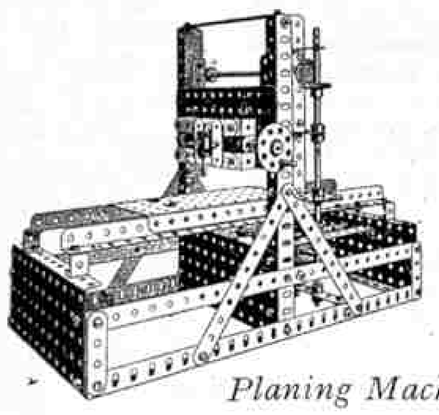
A notable instance of good constructional work is to be found in the First Prize model in Section B. Its builder, Alan Arthur Warren, of Norwich, is only 10 years old and in view of his age his success in winning First Prize is a very creditable achievement. Warren tackled the hydraulic truck, and reproduced the hydraulic action by the following method. Attached to the bottom of the steering handle is a small Fork Piece, which pivots on a ¾" Bolt that is inserted in the front holes of two Cranked Curved Strips, which carry the front wheels. A length of Meccano Cord is tied to the handle just above the Fork Piece. The cord passes over a ½" loose Pulley suspended in a Cranked Bent Strip, and then under another ½" Pulley that is mounted freely (*Continued on page 845*)



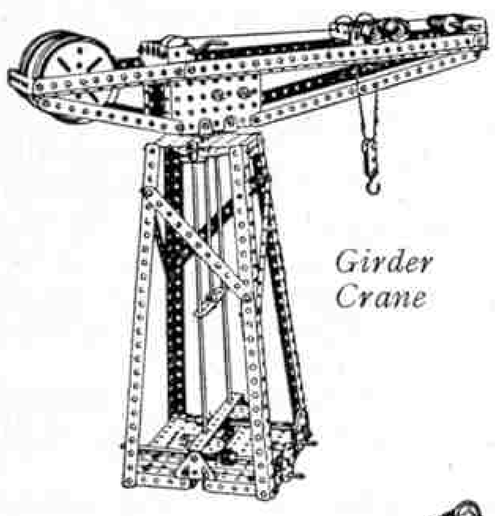
£500 IN PRIZES



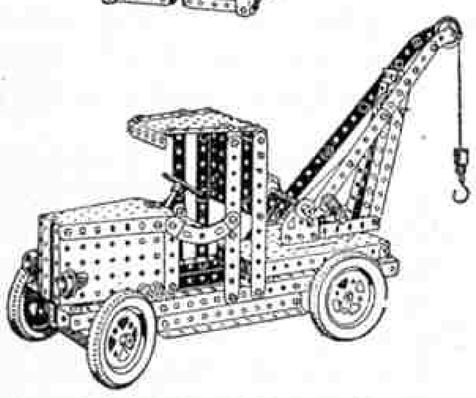
Aeroplane



Planing Machine



Girder Crane



Motor Breakdown Crane

MECCANO MODEL-BUILDING COMPETITION

Every year thousands of new Meccano models are designed and built by Meccano boys. We wish to encourage these inventive boys, and with this object we have planned a new Model-building Contest that is to be the biggest we have ever organised. There will be a large number of Cash Prizes of a total value of over £300. In addition Meccano Outfits and other Meccano products to the value of £200 will be awarded, making a grand total of £500.

In order to compete for these splendid prizes all that is necessary is to build an original model, and send us a photograph or sketch of it, together with any explanation that may be necessary in regard to the special points in its design and mechanism.

Before commencing to build their models competitors should obtain the latest list of Meccano parts, as many wonderful new parts have been added recently.

SECTIONS AND AGE LIMITS

To ensure that each competitor will have an equal chance, regardless of his age, the Contest is divided into five separate Sections as detailed below.

Section A—For competitors over 18 years of age on 31st March, 1932.
Section B—For competitors over 16 and under 18 on 31st March, 1932.
Section C—For competitors over 12 and under 16 on 31st March, 1932.
Section D—For competitors over 10 and under 12 on 31st March, 1932.
Section E—For competitors under 10 on 31st March, 1932.

ASK YOUR DEALER FOR AN ENTRY FORM

Each entry must be accompanied by an official Entry Form, obtainable free from any Meccano dealer. Overseas competitors can obtain their forms from the Meccano agent for their particular country. Any competitor who has difficulty in obtaining an Entry Form should write for one direct to Meccano Ltd., enclosing a 1½d. stamp to cover return postage. Full details of the Contest, together with a complete list of the prizes that are to be awarded, appear on the Entry Form.

Start work on your model to-day. You may be one of the fortunate competitors to win a place in the big Prize List !

Closing Date for All Sections : 31st March, 1932.

Results of Meccano Model-Building Contests

By Frank Hornby

No. 1 and No. 6 "Outfits" Contest (Home Sections)

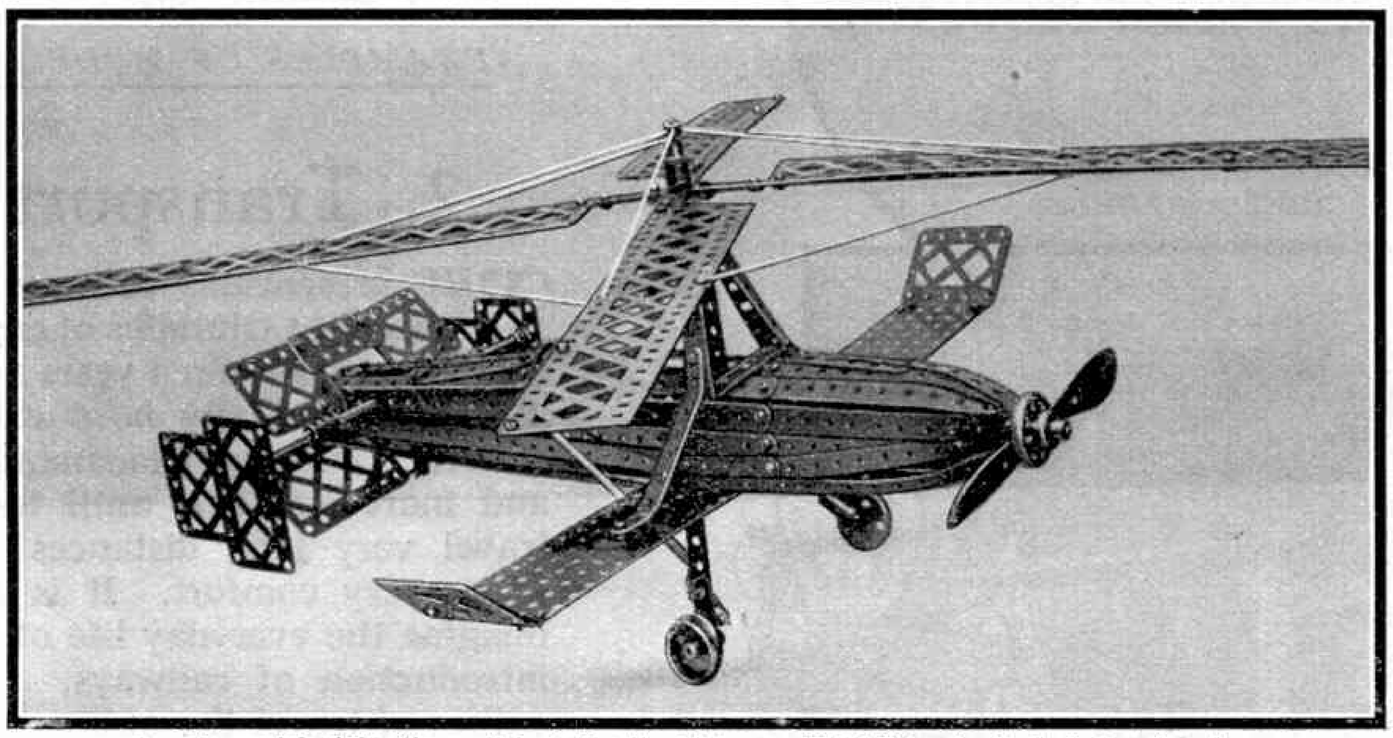
The results of the Home Sections of the No. 1 and No. 6 "Outfits" Contest are as follows :—

Section A (for No. 1 Outfit Models).

FIRST PRIZE, Meccano goods value £2-2s.: J. Wilson, Aberdeen. SECOND PRIZE, Meccano goods value £1-1s.: P. CARTER, Folkingham, Lincs. THIRD PRIZE, Meccano goods value 10/6: F. Croydon, Abbotskerswell, Newton Abbot, Devon.

SIX PRIZES of No. 1a Meccano Accessory Outfits: L. Hedges, Newcastle-on-Tyne; W. Jones, Cardiff; O. Young, Deal, Kent; R. Turville, Birmingham; R. James, Sheffield; N. Clark, Swindon, Wiltshire.

SIX PRIZES of Complete Bound Instruction Manuals: A. Ruston, Berkhamsted; D. Fryer, Glusburn, near Keighley, Yorks.; J. Oppermann, Devizes, Wilts.; J. Palmer, Berkhamsted; E. Doorley, Dublin; S. Cutteridge, Wimblington, near March, Cambs.



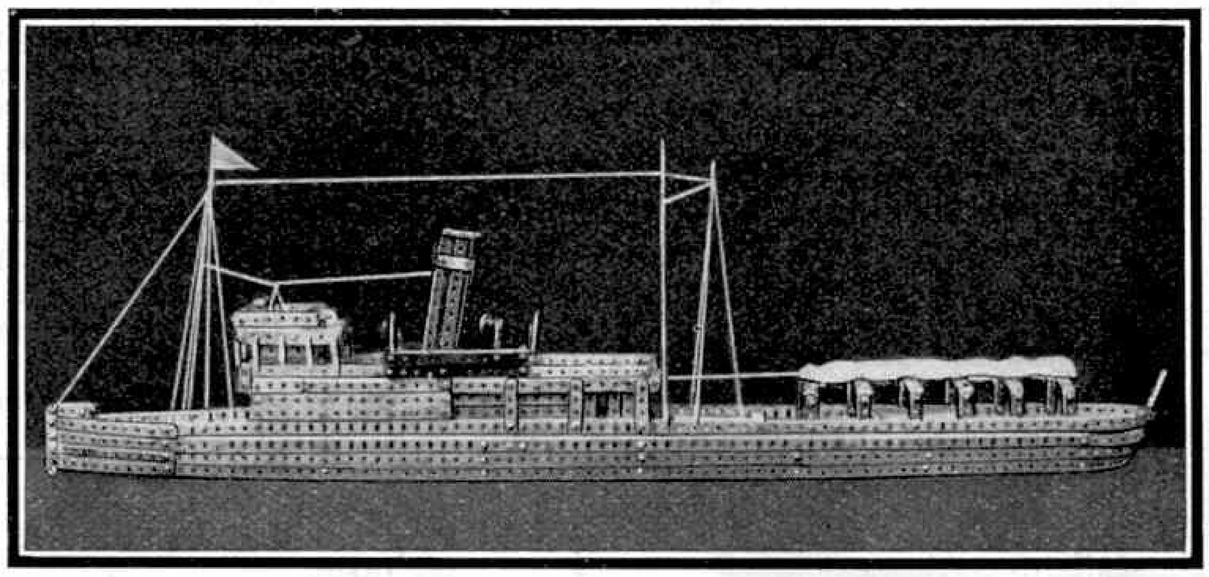
A scale model of the Cierva "Autogiro," which won Third Prize for L. A. Laker, London.

TWELVE PRIZES of Meccano Engineer's Pocket Books and Certificates of Merit: H. Parker, Manchester; T. Gunner, Ogmore Vale, Glamorgan; R. Naden, Leek, Staffs.; L. Bailey, Newark, Notts.; J. Thompson, Romiley, near Stockport, Cheshire; E. Chamberlain, Birmingham; G. Bishop, Worthing, Sussex; J. Gellatly, Islington, London, N.; G. Hawkins, Erdington, Birmingham; B. Hodson, Stroud, Glos.; L. Marchant, London, S.W.20; G. Smith, Rhu, Dumbartonshire.

Section B (for No. 6 Outfit Models).

FIRST PRIZE, Cheque for £3-3s.: J. Lee, Bolsover, near Chesterfield; SECOND PRIZE, Cheque for £2-2s.: C. Kauffman, Chapeltown, Leeds. THIRD PRIZE, Cheque for £1-1s.: L. Laker, Walthamstow, London, E.17.

SIX PRIZES, each of a Cheque for 10/6: M. Finnemore, Sutton Coldfield; P. H. Firkins, Harborne, Birmingham; A. Farr, Forest Hill, London, S.E.23; T. Royden, London, S.W.; R. Makin, Birmingham; W. Smith, Bradford.



J. L. Lee, Bolsover, made good use of his No. 6 Outfit in building this fine model ship.

SIX PRIZES of Meccano goods value 5/–: C. Wrayford, Moretonhampstead, Devon; J. Yeats, Farnham, Surrey; G. Good, Stoneycroft, Liverpool; T. Simpson, Belfast; B. Shorten, Cork, I.F.S.; M. Young, Purley, Surrey.

TWELVE PRIZES of "*Famous Trains*" by C. J. Allen: R. Taylor, Studley Priory, near Oxford; J. Mapplebeck, Huddersfield; R. Robbins, Chester; L. Boston, Paddington, London; P. Rogers, Blackburn; N. Cox, Filton, Glos.; K. Halliday, Everton, Liverpool; P. Pitt, Heronsgate, Herts.; J. Gooch, Twickenham; F. Downing, Silverdale, Staffs.; J. Meakin, Cheadle, Staffs.; H. Webb, Wood Green, London, N.22.

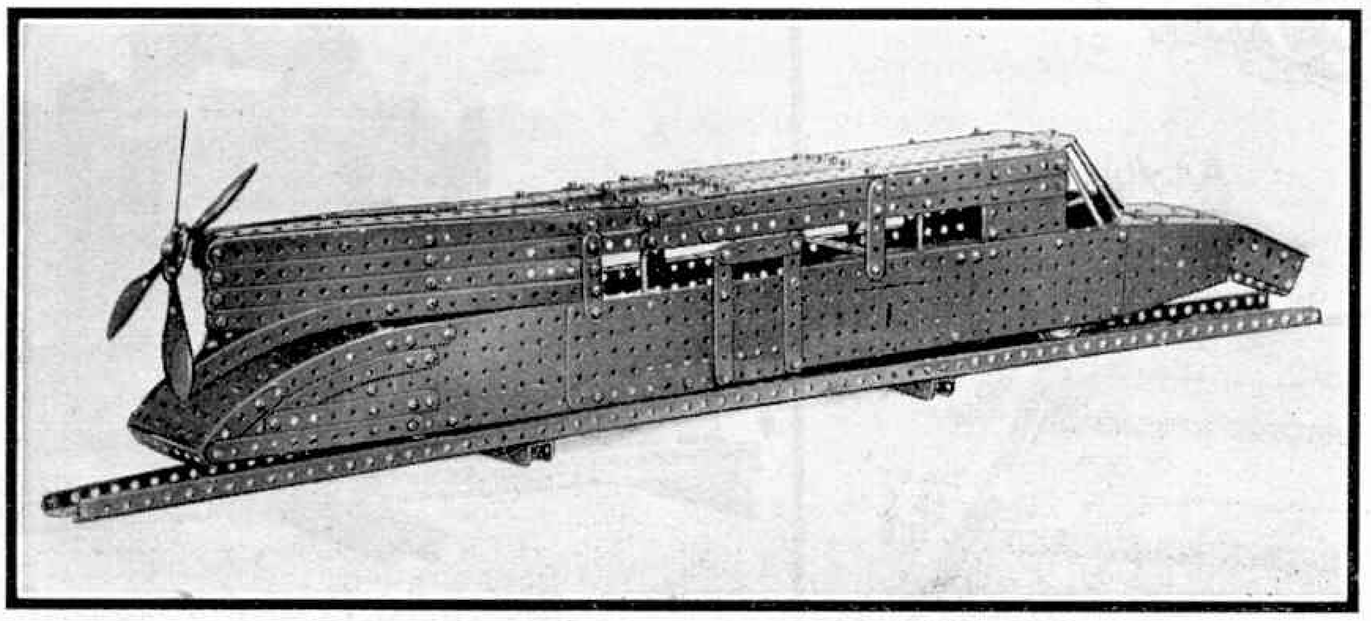
I have noticed in recent Contests marked similarity in many of the models, and it would appear that the majority of competitors do not give sufficient attention to the choice of an original subject. In these circumstances, therefore, it is not unusual for a competitor who sets himself to find a really original subject for his model to carry off the principal prize, although in point of construction his model may fall short of the standard attained by other competitors. To win a prize in a Meccano model-building contest a model must be original as well as soundly constructed, and should display whenever possible new uses for the Meccano parts. Intricate models of perfectly sound construction, yet lacking in originality, seldom win prizes. That is why many of the competitors in this contest failed to find a place in the prize lists.

Another matter that sometimes spoils a competitor's chance of winning a prize is the manner in which the entry is prepared and submitted. Some competitors build really fine models, but instead of having a clear photograph taken, or spending an evening making a neat and careful drawing of their models, they hurriedly scratch a few lines with the stump of a pencil on any old scraps of paper that lie to hand, and then submit these as drawings! In a recent contest one competitor sent a tiny sketch drawn on a confectioner's bag! Of course, it is impossible for the competition judges to pay much attention to entries of this sort, when few if any of the essential details are discernible. I hope that those competitors who are in the habit of submitting their entries in this careless manner will endeavour in future to mend their ways, because they are simply throwing away chance after chance of winning handsome prizes.

The First Prize model in the No. 6 Outfit Section is a ship. It was built by J. L. Lee, and its clean and symmetrical appearance is an achievement that will be better appreciated when it is learned that the overall length of the ship is nearly 5 ft., and that it has a beam of 6½ in.

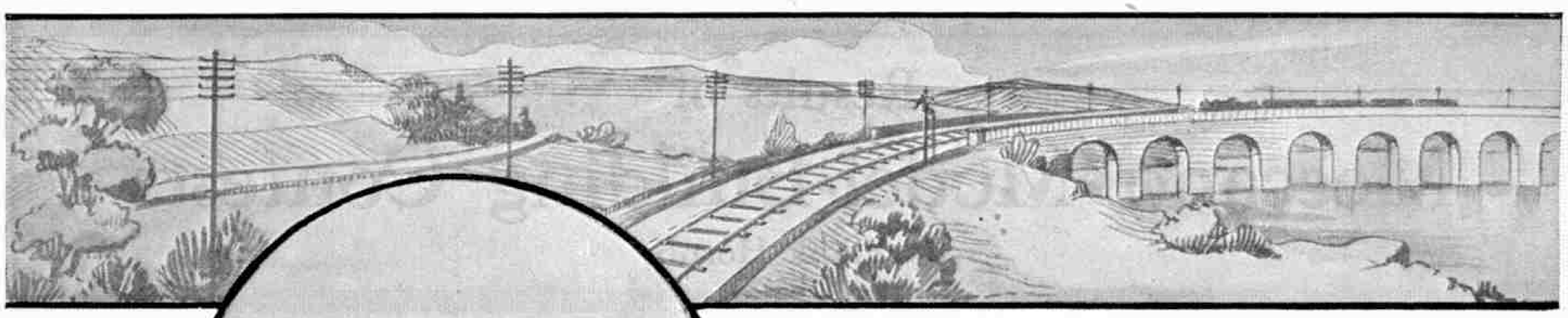
The Second Prize model is a reproduction of the interesting Zeppelin Rail Car, now undergoing trials in Germany.

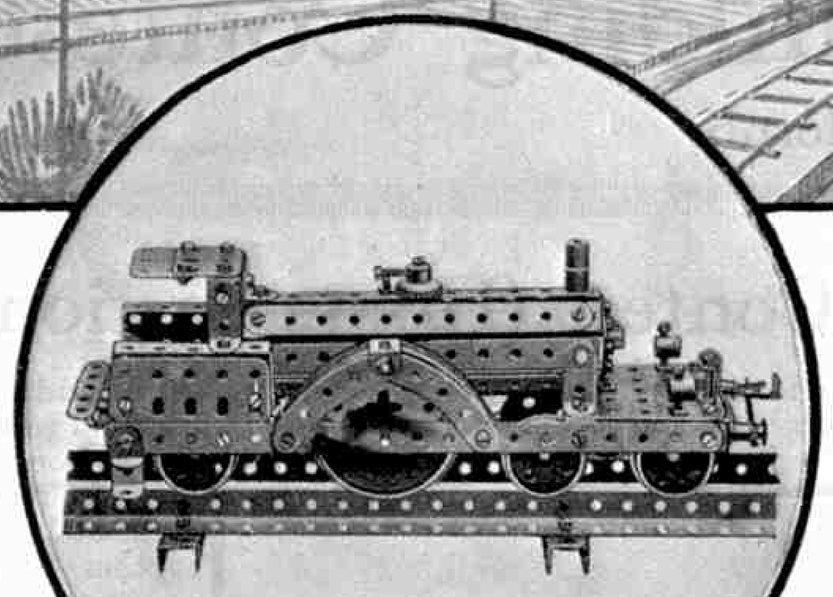
The model derives its motion from a propeller driven by an Electric Motor concealed in the interior of the body.



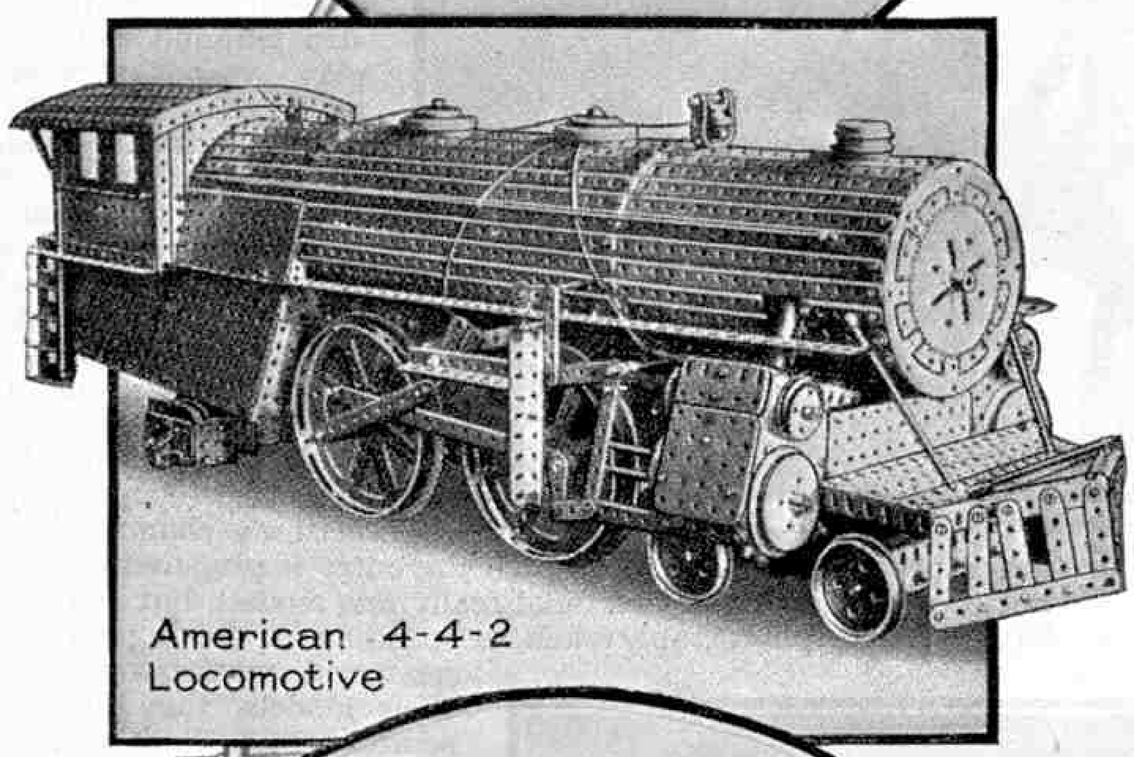
C. Kauffman's (Leeds) original model of the Zeppelin Rail Car.

(*Continued on page 854*)

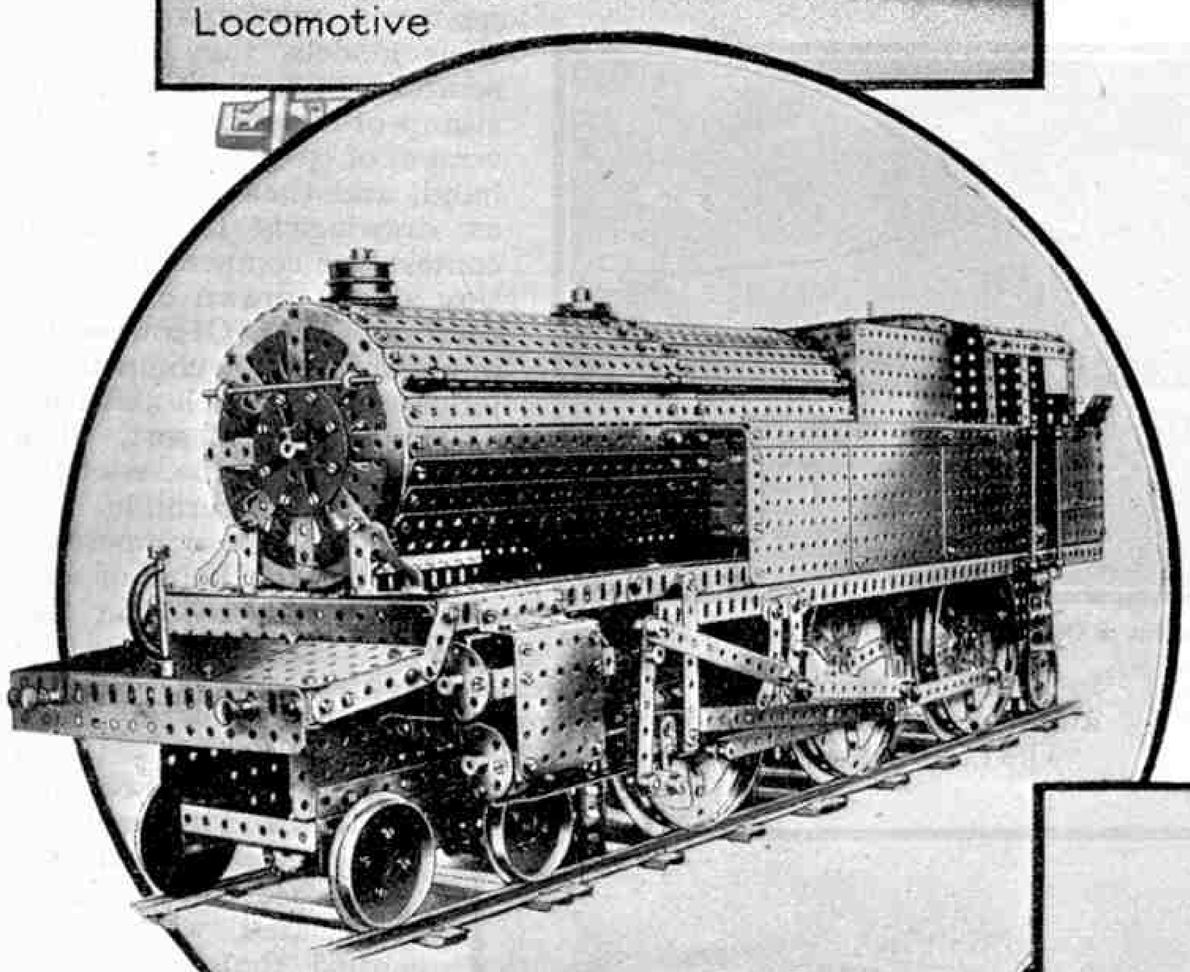




An old-style Midland "Single-wheeler"



American 4-4-2 Locomotive



A typical Meccano Tank Loco.

MECCANO

EXAMPLES OF MODEL CONSTRUCTION:

2. Transport by Rail

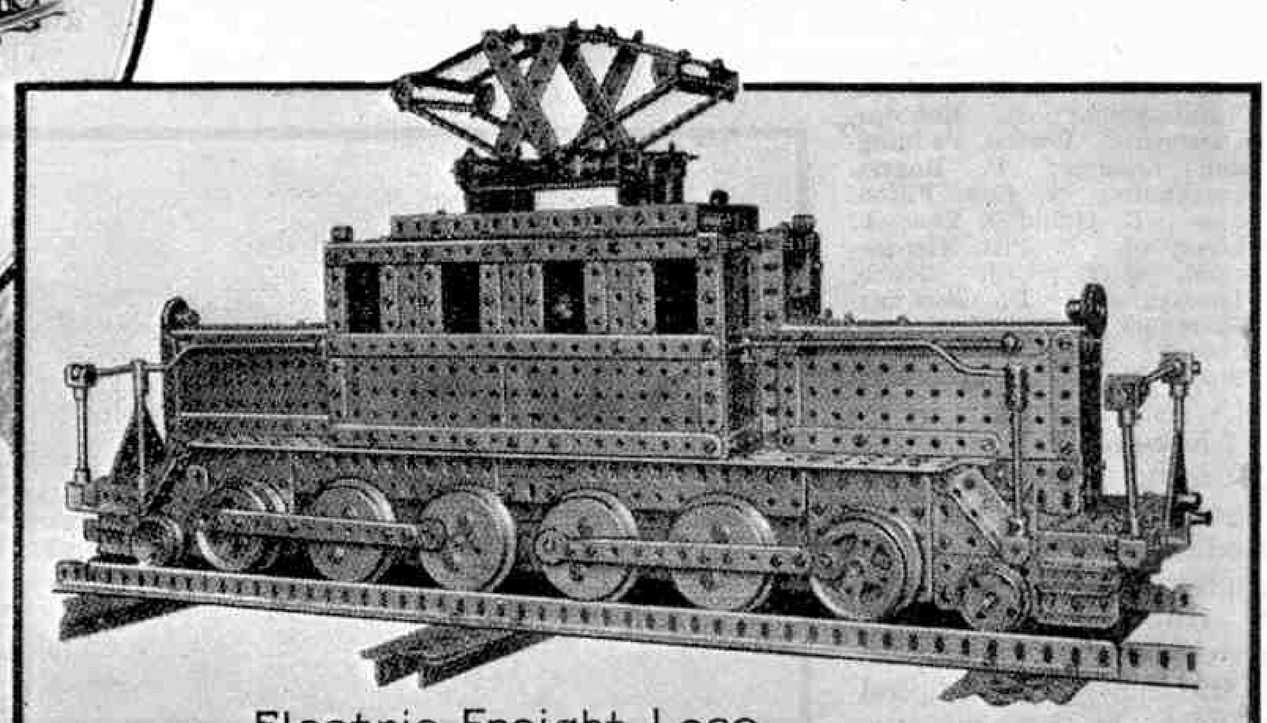
THE present-day railway system is one of the greatest triumphs of engineering. For more than a hundred years a vast network of steel rails has gradually been extending all over the country. Means of locomotion have grown more and more efficient, until to-day we are able to travel very long distances at high speed and with every comfort. It is almost impossible to imagine the everyday life of the public before the introduction of railways. Because of the difficulties of travel the ordinary individual a century ago seldom ventured far from his native town or village, with the result that the countryside beyond a certain radius was as remote to him as a foreign land.

Railway Transport is represented by a number of fine Meccano models, as will be seen from the examples shown here. Locomotives made with Meccano parts are not only realistic in appearance but they may be driven by the Electric or Clockwork Motors and employed in building up complete working model railways.

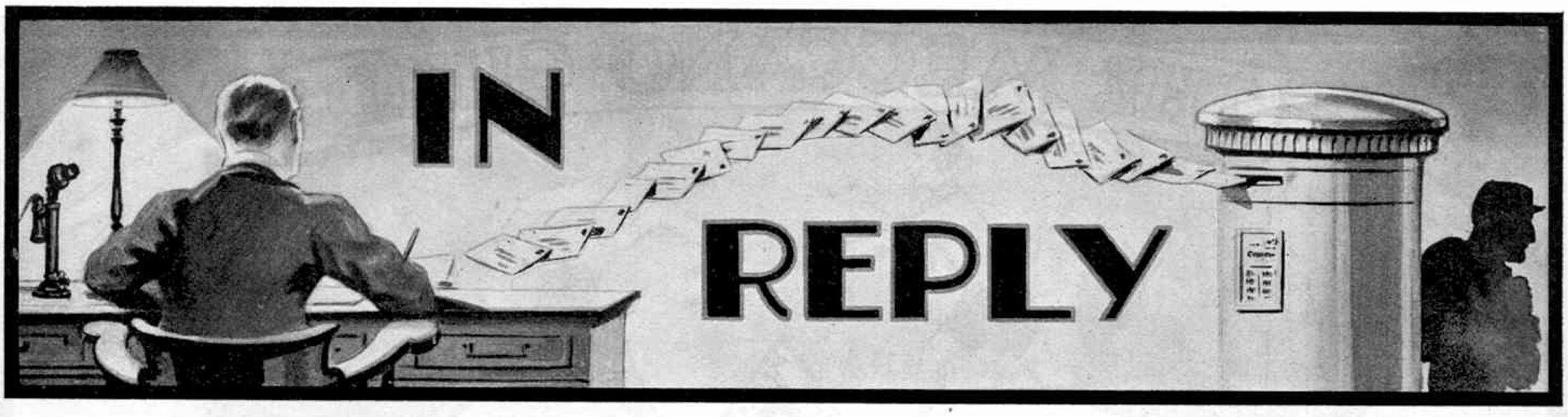
The old style "Single-wheeler" illustrated forms the subject of Model No. 7.4 in the 5-7 Meccano Manual, and the Tank Engine is described and illustrated in Special Instruction Leaflet No. 15 (price 3d. from any Meccano dealer, or 3d. post free from Meccano Ltd.).

Meccano Outfits range in price from 2/6 to 450/– and may be obtained from all leading toy stores. Ask to see them.

MECCANO LTD., Old Swan, LIVERPOOL



Electric Freight Loco.



PROBLEMS AND IDEAS OF INTEREST TO ALL MODEL-BUILDERS

THE NEW MECCANO PARTS

All model-builders will be interested in the new Meccano parts that have just been announced, and notes on the uses and operation of some of these will consequently be useful.

One of the most important of the new parts is the 2½" Gear Wheel, part No. 27c. This new Gear has 95 teeth, so that when it is meshed with a standard Meccano ½" Pinion a gear ratio of exactly 5 : 1 is obtained. This ratio will be found very useful indeed in the construction of all kinds of models and mechanisms. Model-builders will also note that in addition to giving a 5 : 1 ratio, the new Gear makes possible the construction of gear ratios of 10 : 1, 100 : 1, etc., and it thus provides a wide field of utility in models of counting and recording machines designed on the metric system. It is of course only necessary to use a 2 : 1 gear train, composed of a Meccano 50-teeth Gear Wheel and a ¾" Pinion, in conjunction with the 5 : 1 ratio, in order to produce a decimal ratio.

Readers will note that the new Gear fills the gap that previously existed between the large 3½" Gear Wheel, No. 27b, and the 57-teeth Gear (diameter approximately 1½"). The Gear provides a ratio of 5 : 1 at 2" between centres when used with the ½" Pinion, or 2½ : 1 when used with a Meccano 1" Gear at 1¾" between centres (non-standard spacing).

GREASE CUP LUBRICATION

As was emphasised last month, the question of correct lubrication in Meccano models is a very important matter. For general lubrication purposes in models the Meccano Oil is ideal, and this may be applied to the bearings of working models at intervals by means of the Meccano No. 1 or No. 2 Oil Can. An alternative method of lubrication that is used extensively in actual engineering is by the use of semi-solid lubricant fed to the bearings under screw pressure. This method is known as the "Stauffer" system of lubrication, and in order to enable model-builders to reproduce this interesting feature in their models we have now introduced special miniature Grease Cups (part No. 174), which are almost perfect reproductions of actual "Stauffer" lubricators. These new Meccano lubricators consist of threaded brass cups that may be screwed into the set-screw holes of the bosses in which the Rods turn. Each cup is provided with a milled brass cover, which may be screwed on over the cup.

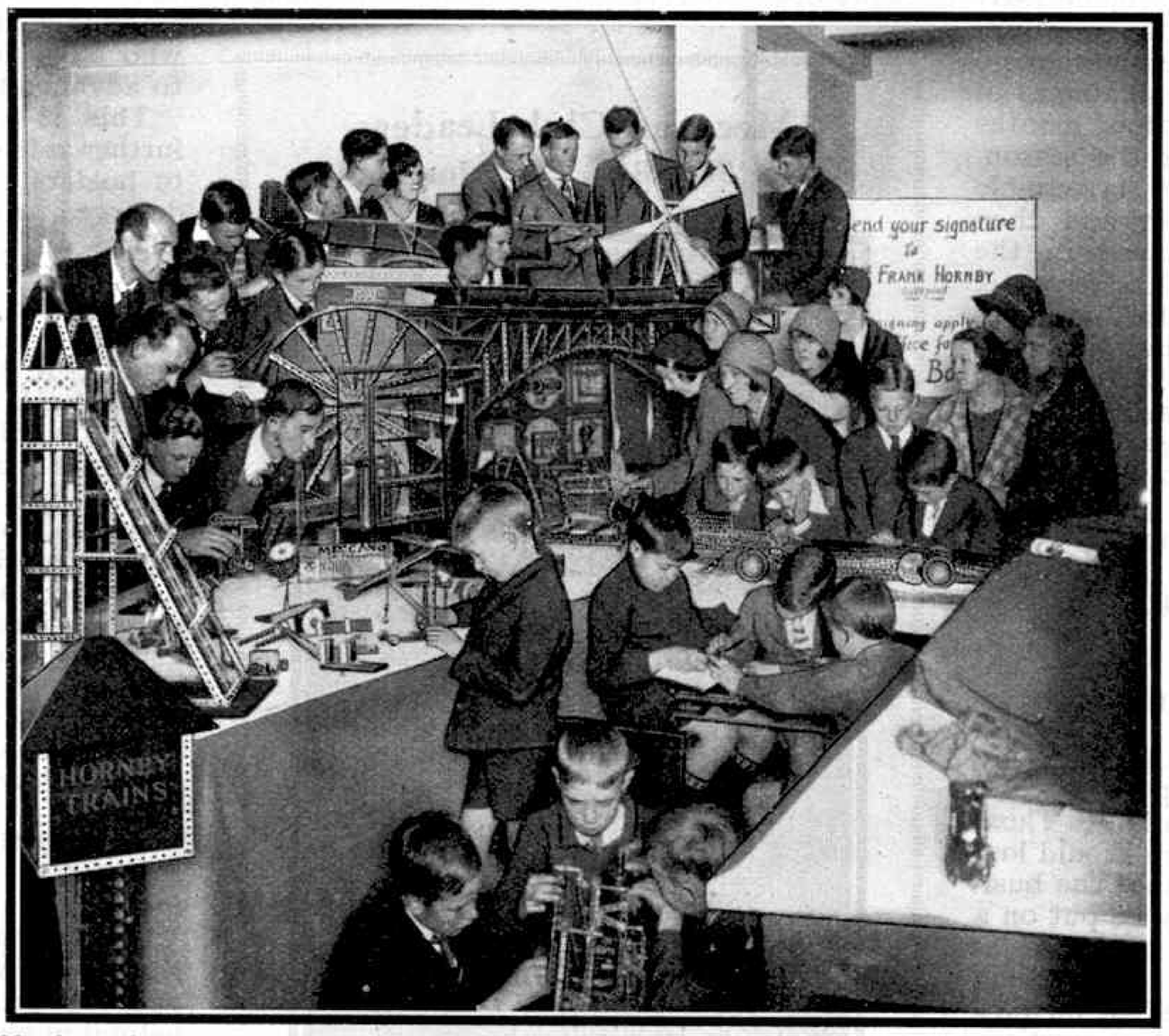
Both the cup and the cap should first be filled with a semi-solid lubricant such as petroleum jelly ("vaseline" can be used), and the cap should then be screwed down over the brass cup. This will cause some of the lubricant to be forced through the set-screw hole on to the revolving axle.

The rotating action of the axle soon reduces the lubricant to a liquid consistency so that it acts in a very similar manner to the Meccano Oil. As the lubricant forced on to the axle becomes used, it is only necessary to turn the milled cap to force fresh grease on to the axle.

The Meccano Cups are very small indeed and they take up very little room when fitted to bosses. An application for the Cup is in the crankshaft of the Horizontal Engine, Super Model No. 11. A Grease Cup may be employed with great advantage here in place of the existing Handrail Support and Washer. It will be obvious that it is not possible to employ them at every lubricating point, but if they are used at most of the main bearings a great improvement will result.

IMPROVED METHOD OF SECURING SPRING CORD

Most model-builders will be familiar with the Meccano Spring Cord Coupling Screw, part No. 58a, which is used to connect the ends of a length of Spring Cord so as to form an endless driving belt, etc. The Coupling Screw obviates the rather difficult operation of drawing out and twisting together the ends of the Spring.



Members of the Malvern and Turffontein Meccano Clubs inspecting the wonderful array of models at an Exhibition arranged by Mr. A. E. Harris, agent of Meccano Ltd. for South Africa, in his showrooms at Johannesburg. The models on view included the Big Wheel, Watt's Beam Engine, and a model of the Loetschberg Bridge, Switzerland. Visitors were greatly interested in ingenious models of a Steam Dredger and No. 3 Shaft at the Geldenhuis Deep Mine built for the Exhibition by junior members of the two Meccano clubs.

Besides being employed for driving belts, the Meccano Spring Cord is also used extensively as a light tension spring, as for example in the construction of a Pawl and Ratchet mechanism. It is then of course necessary to anchor the ends of the Cord to the Pawl and a fixed portion of the model. We have now introduced a part that will greatly facilitate this operation. This is the Meccano Spring Cord Coupling Hook, part No. 58b, and it is designed to be screwed into the end of the Cord, and the hook slipped into the hole in the Pawl, Strip, Plate, etc. This produces a much more satisfactory connection than the old method of softening the end in the flame of a match and twisting the cord round a bolt, etc. In addition a tension spring consisting of a length of Spring Cord fitted with two Coupling Hooks can be removed in a moment. Altogether model-builders will find these Hooks very useful.

The best suggestion for a new or improved Meccano part sent in during the month of August was submitted by T. J. Perry of Edinburgh, and the monthly award of 10/- has therefore been awarded to him. The winning idea was for an ingenious 'displacement' lubricator that could be applied to the Meccano Steam Engine.

ANCHORING THE HOIST CORD; ANOTHER PROBLEM SOLVED

The problem of anchoring the hoist cord neatly and efficiently to the Crankhandle or winding shaft in a Meccano crane has always proved troublesome. When the cord is merely tied to the shaft it is difficult to raise a heavy load owing to the loop made on the end of the cord slipping round on the smooth axle. From time to time readers have written to us suggesting that we should bore a hole in the centre of the Meccano Crankhandle so that the cord could be passed through and thus anchored in place positively. This idea is good, but it suffers from the drawback that the point at which the cord may be attached is fixed (centre position), while in certain cases it is better to anchor the cord at one end. Also Standard Axle Rods are often employed as hoist shafts, and it would obviously be impracticable to drill holes in the Rods for this purpose. The problem has now been solved by the introduction of the Meccano Cord Anchoring Spring, part No. 176.

This very ingenious device consists essentially of a small coil spring, one end of which is formed into a loop so that the end of the hoist cord can be attached to it. The other end of the coil is ground to a knife-edge so that it bites into the axle and provides a rigid anchoring point. To use one of these Anchors, the part should be placed over the end of the hoist shaft and twisted in an anti-clockwise direction (almost as though the Rod were threaded) until the Anchor is in the required position. It will be found impossible to push the Anchor directly into position, and no attempt should be made to do this. After the Anchor has been screwed into position, the hoist cord should be attached to the loop, and it will then be found impossible to cause the Anchor to slip round on the Rod when a pull is exerted in a clockwise direction. The greater the force applied, the greater is the grip of the Anchor on the Rod.

These Anchors are only about ¼" long, and they therefore present the neatest and most efficient method of securing the hoist cord of a crane. They also possess the advantage of being very adaptable, as they can be fitted to any standard Meccano Axle or Crank Handle, etc.

POINTED BEARING.—A bearing having a very low friction factor would be useful in constructing model gyroscopes, clocks and delicate machinery where the axles are required to turn very freely. Your suggested bearing would consist of a special bolt having the end of its shank formed into a pointed cone. The coned end of the bolt would rest in a conical depression cut in the end of the axle that was required to pivot. In this way the frictional contact between the rotating and stationary members would be reduced to a minimum. You will be interested to hear that we have had a scheme for conical bearings and pointed pivots under consideration for some time now. We hope to make a definite announcement regarding these parts in the "*M.M.*" shortly. (*Reply to G. Hunter, Edinburgh*).

SHOCK ABSORBER.—A heavy coil spring fitted at each end with a standard boss would have a certain amount of application as a shock absorber in models of cars, buffer stops, and the like. It might also be employed as a flexible transmission joint, but this function is now covered by the new Meccano Flexible Coupling, part No. 175. (*Reply to H. Lane, Stokesley*).

In Full Swing

During this month all Meccano clubs settle down to the regular work of the first of the two winter sessions, although in most instances enthusiasm has this year been so great that a resumption of active indoor meetings was made early in September. Every year the tendency to continue meetings throughout the summer becomes more apparent. As a rule, the programmes of meetings held during the outdoor months are specially planned to suit the season. The weather is not always favourable during the summer, however, and then model-building or games played in the club room provide a never failing resource. The advantages of keeping the members together by means of this kind is plainly shown when autumn comes. From time to time during the summer informal talks over the plans for the coming winter have taken place, and the actual programme to be followed crystallises out more quickly than if no meetings are held before September or October. Members get into their stride more quickly and little time is wasted in preliminaries.

The Recruiting Campaign

I wish to remind secretaries that supplies of report forms, membership cards, and subscription cards are now available. Those who have not applied for them should lose no time in doing so in order that the business affairs of their clubs may be put on a firm foundation at the very beginning of the session.

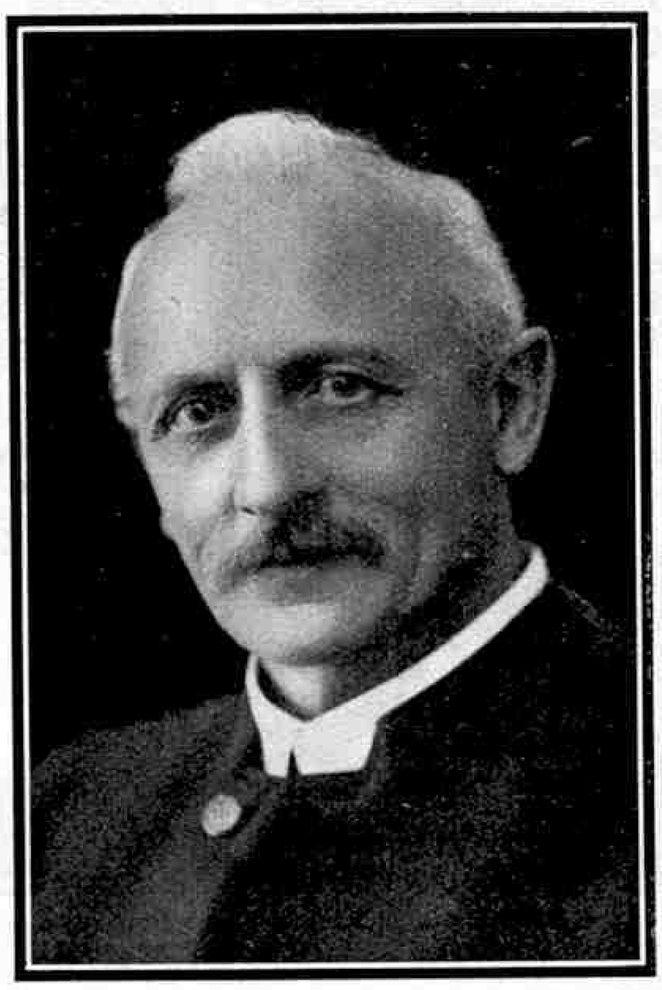
I shall also be very pleased to forward supplies of other Guild literature, particularly that useful for recruiting purposes. The present is a very good time in which to plan a campaign for obtaining new members of the Guild, and in order to help in such a campaign an entirely new form of leaflet has been prepared. This states plainly the aims and objects of the Meccano Guild and explains the privileges of membership of that organisation and of the Correspondence Club as well as the advantages of forming Meccano clubs. Full directions for joining the Guild are included, and the application form is now incorporated with the leaflet, instead of being an entirely separate form, as previously.

Supplies of the combined leaflet and application form will be forwarded to any member of the Guild who wishes to join in the campaign, full details of which will be supplied on application. A Recruiting Medallion is presented to any boy who obtains three new members for the Guild, and if any member already possessing this award secures six further recruits, his name is engraved for him on the back of his Medallion, together with the words "Special Award."

It is important that every boy taking part in the campaign should make sure that his name and address appear on each form that he gives to a friend. This may be written at the foot of the application form, and its appearance there will enable me to keep a correct record of each member's recruits.

Meccano Club Leaders

No. 54. Rev. F. P. Joseland



The Rev. F. P. Joseland was President of the Hampton (Victoria) M.C. from the commencement of the club until February 1929, and on his removal to Castlemaine founded the Castlemaine (Victoria) M.C., of which he is Leader. The club was affiliated in October last year and under his skilful direction is making excellent progress. Model-building Competitions and Lectures are attractive features of club work and members are keen Hornby Train enthusiasts.

Award of Merit Medallions

I hope that further nominations for Merit Medallions earned during the summer session will be forwarded to me without delay in order that I may have the required medallions engraved. Nominations must be made by the Leader of the club, and the awards should be made to the members who have done most during the summer to advance the interests of the club.

This is a convenient place to make further reference to the Bar to be awarded to holders of Merit Medallions who have deserved further recognition of their efforts on behalf of their clubs and of the Guild. The first announcement of the introduction of this new award was made in the July issue of the "*M.M.*," and in making it I asked for suggestions from Leaders and others interested in club work for the words to be inscribed on the Bar. These may be either Latin or English and should indicate as concisely as possible that the Bar is supplementary to the Merit Medallion. I have already received a number of interesting suggestions for a suitable inscription, but no decision has yet been made and I shall be very pleased to hear of further ideas. As already announced, one Bar will be awarded in each club, and I hope to make the first presentations early in the New Year.

Announcements of Coming Events

The paragraph on "Coming Events" that has now appeared regularly in these pages for more than a year has been very helpful in securing good attendances at the exhibitions and other functions announced in it. I am always pleased to insert notices of this kind and I hope that even greater use will be made during the coming winter of this means of bringing the work that is being done in the clubs to the notice of Meccano boys and others interested.

I have sometimes been compelled to disappoint the hopes of officials and members of a club that an announcement of their exhibition would appear in the "*M.M.*" because their notice has reached me too late. Details of coming events should reach me at least five weeks before the appearance of the issue in which they are to be mentioned. Announcements of exhibitions to be held during the Christmas and New Year season should be forwarded even earlier, 15th October and 15th November respectively being the latest dates for notices to appear in the December, 1931, and January, 1932, issues.

Proposed Clubs

Attempts are being made to establish Meccano Clubs in the following places and boys interested should communicate with the promoters whose names and addresses are given below:—

AUSTRALIA—G. K. Ludbrook, No. 7, Short Street, Granville, N.S.W.
BARROW-IN-FURNESS—B. H. Bruce, 108, Victoria Road.
DUNDEE—Gordon Bogan, 46, Mortimer Street.
GOSPORT—S. G. M. Liddle, 18, Lees Lane.

CLUB NOTES

Fulstow Junior M.C.—Hornby Train nights and Model-building Competitions have been held, and Lantern Lectures have been given on various subjects of interest. Table Tennis and Table Cricket are popular, and many good games have been played. An interesting fishing match was organised through the kindness of the owner of the fishing ponds, Mr. T. E. Marshall, and a most enjoyable time was spent. Club roll: 16. *Secretary:* J. C. Phillips, P.O. Fulstow, North Thoresby, Lincs.

South Croydon and Purley M.C.—Good progress is reported and a hall has been secured. Meetings are now being held regularly for Model-building, Lectures, and Games. An interesting Lecture on "*Driving the 10.30 Limited*" was given by the club secretary. A Stamp Section and a Library have been formed, and are proving attractive. A Treasure Hunt for a box of Meccano parts was held in the club-room and provided an interesting evening. Club roll: 23. *Secretary:* A. Bawden, Dunedin, 9, St. Augustine's Avenue, South Croydon, Surrey.

Laindon M.C. — Membership shows an increase, and an interesting outdoor programme has been followed. Cycle runs and rambles to places of interest have been held, and the members have given these their full support. The club has a splendid Hornby Train Layout, and work on the track is carried on regularly. The construction of a ship coaler has proved an attraction, each member building a separate part. Fretwork is a new feature. Club roll: 17. *Secretary:* J. P. Tourle, "St. Ives," Leicester Road, Laindon, Essex.

Holy Trinity (Barnsbury) M.C.—The second session has been very successful and a good programme has been followed. This has included Debates, Talks by members, and Model-building. The Seventh Annual Concert was a great success, the sketch "*Buster*," given by the members, being very much enjoyed. On this occasion several club Lantern Slides were shown. Outings have been held, including visits to Messrs. Spaldings, Croydon Aerodrome, and The L.U. Tram Depot at Fulwell. A printing machine has been purchased for club use, and it is hoped to print a Magazine in the near future. Club roll: 44. *Leader:* Mr. Stuart H. Wilson, 29, Thornhill Road, Barnsbury, London, N.1.

Sligo (Ireland) M.C.—Members had a very jolly time together at Camp, at a seaside resort. Meccano Model-building was carried out on the shore with great success, and a Sand-building contest was held. Jim Paterson, one of the members, saved the life of a small boy who was in danger of drowning, and his courageous act won general admiration. A display of Meccano models in the window of a local Meccano dealer's shop attracted much attention, and it is hoped that the membership will increase as a result of this display. A Lecture on "*The Wonders of Engineering*" was given by Mr. Fox, and this was followed by a display of Lantern Slides showing large structures of steel throughout the world. Mr. W. M. Johnson, the club President, gave an enjoyable picnic for the club members and members of the H.R.C. Branch. Club roll: 18. *Secretary:* Kevin McMenamin, 78, John Street, Sligo, Ireland.

St. Edmundsbury M.C.—The attendance at meetings has been very good, and several new members have been enrolled. Model-building meetings have been held, and the Hornby Layout has attracted much attention. The third Social Evening was very successful, the models displayed being of a high standard. Prizes for models were awarded by Mrs. Hagger. Various "side shows" were arranged, and refreshments were served. Club roll: 18. *Secretary:* H. S. Minns, 35, Out Risbygate, Bury St. Edmunds.

Wembley M.C.—A successful Exhibition was held, at which a splendid collection of models was displayed. A model of the Horizontal Steam Engine was loaned from Headquarters, and a large Hornby Train Layout was on view. Model-building Competitions are arranged from time to time. Outdoor Hornby Train operations have been carried out with much success. Games meetings are enjoyed, and when possible these are held out of doors. Club roll: 16. *Secretary:* Eric Curtis, 45, Monks Park, Wembley.

Westbury M.C.—The Second Annual Exhibition was a great success, the models being varied and well constructed. During the exhibition two films were shown and a collection was taken. The Leader was presented by the members with a wristlet watch as a token of appreciation of his work. Cricket and Baseball matches have been held, and Model-building Competitions have been keenly contested. Prizes for these competitions were given by Mr. G. Munt, who takes a great interest in the club's progress. Club roll: 30. *Secretary:* E. D. Moye, 24, Burnell Rise, Letchworth.

Attenborough Church Choir Boys' M.C.—Talks on "*The Tourist Trophy Races*" by Mr. C. Dennis, the Leader of the Club, and on "*Model Aeroplanes*" by Mr. Lowe have been given. Mr. Lowe kindly offered to supply the necessary materials to all boys who desired to make models for themselves. Members' efforts in preparation for the Exhibition were well rewarded, for the event was very successful, the proceeds amounting to £1-13-6. Prizes were presented by Mr. H. F. Wicks, the former Leader. Club roll: 23. *Secretary:* G. W. Render, 34, Church St., Beeston.

Our photograph shows the original members of the New Durban (South Africa) Meccano Club. This club now has a membership of 70. Affiliation was granted in May 1930. An excellent programme of Meccano Model-building, Hornby Trains, Lantern Lectures, Socials and Outings is followed.

Leigh (Sherborne) M.C.—Games and Outdoor events have constituted the chief features of recent programmes. On one ramble points were awarded for birds' nests and eggs discovered, the nests themselves being undisturbed, of course. At other meetings lead soldiers and similar objects have been made for sale, the proceeds being devoted to club funds. Club roll: 10. *Secretary:* C. Hannam, Holmbushes Farm, Longburton, Sherborne.

Ramsey M.C.—A considerable amount of time has been spent in improving the club-room ready for the winter session. Two members submitted models in a local Arts and Crafts Exhibition, and one was successful in securing a prize, while the other was highly commended. Several members entered models in the Flower Show held on August Bank Holiday. Club roll: 12. *Secretary:* C. Butcher, Princess Street, Ramsey.

Clacton and District M.C.—The club recently enjoyed a visit to the local Printing Works, and the members very much enjoyed the privilege of seeing the newspaper printed. A Social Night has been held, and a competition organised in connection with it was quite successful. Games were played, and afterwards refreshments were served. A good open-air programme has been followed during the summer, and the members have attended very well. Club roll: 17. *Secretary:* M. H. Carter, 12, Wellesley Road, Clacton-on-Sea.

Ainsdale M.C.—The summer programme was much enjoyed, the chief activities being Cycle Runs, Walks, and Cricket. Members spent a camping holiday at Prestatyn, North Wales, in charge of Mr. W. E. Williamson, the Leader. Club roll: 12. *Secretary:* J. Aspinall, 10, Shore Road, Ainsdale.

Mallow M.C.—To celebrate the club's affiliation with the Guild a "Feast" was held. Visitors were invited, and a most enjoyable evening was spent. A cricket team has been formed, and matches against local teams have been arranged. In the School Sports, Meccano Outfits were presented as prizes, and there was keen competition for them. Cycle Tours and Rambles have been included in the programme, and an interesting feature of these is that the members take their Meccano Outfits with them in order to construct models. Debates are held weekly, and the Library formed some time ago is making rapid strides. Club roll: 16. *Secretary:* Willie J. Roche, 8, Spa Walk, Mallow, Co. Cork.

NEW ZEALAND

Wellington M.C.—This club received affiliation some time ago, and good progress is reported. Meccano Model-building and Hornby Train nights are successful, and a good track has been laid in the club-room. The "*Wellington Meccanitan*," the club Magazine, is published on the first meeting of each month, and contains club news, engineering notes and short articles. Club roll: 15. *Secretary:* J. E. Barnsley, Jnr., Newport Terrace, Seatoun Heights, Wellington, New Zealand.

Sumner (Christchurch) M.C.—The membership has increased and meetings have been greatly enjoyed. Competitions are held, and marks are given for models. A prize will be awarded at the end of the session to the boy having the highest total. Lectures by members are frequently given, and marks are also given for these. A good train layout has been laid down in the club-room, and operations on Hornby nights are carried out with great enthusiasm. Club roll: 20. *Secretary:* I. Booth, Head Street, Sumner, Christchurch, New Zealand.

CANADA

Moose Jaw M.C.—Competitions are held regularly and many excellent models have been submitted by members. It is hoped to have a Hornby Train layout in working order in the near future. A short talk on "*The Origin of Flying*" was much enjoyed. A Magazine section has been formed, and the magazines are available to all members. Club roll: 25. *Secretary:* Sam Baxter, 804, Athabasca Street, E. Sask., Canada.

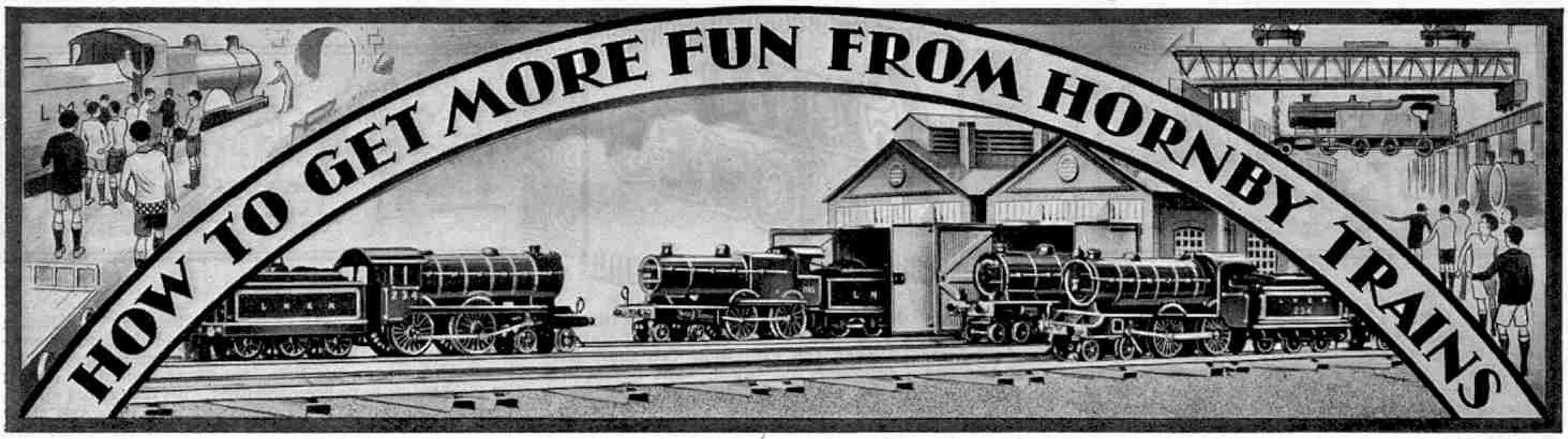
Victoria M.C.—Model-building meetings are popular, and Lectures and Debates are a regular feature of the programme. Prizes have been offered in various competitions by Messrs. Barber's Toy Store, and competition for these is very keen. A Lecture on "*The Production of a Modern Newspaper*" was given by P. Hartnell, and a talk on "*The Motion Picture Industry*" by the secretary, both being greatly enjoyed. Games nights are arranged from time to time, and picnics are included in the programme. Club roll: 9. *Secretary:* Murray D. Bryce, 908, Heywood Avenue, Victoria, B.C., Canada.

SOUTH AFRICA

New Durban M.C.—Model-building Competitions are frequently organised. Lectures by members are given, and in many cases these are demonstrated by Meccano Models. A visit to the Linotype works of Messrs. T. A. Beatty was greatly enjoyed, and as a souvenir of this visit each member was presented with his name set up in type. A Library was started some time ago, and is very successful. A picnic to Salisbury Island was a great success, and a large number of members attended. Club roll: 52. *Secretary:* C. O. Pottinger, 40, Ayott Avenue, Durban, South Africa.

AUSTRALIA

Melbourne (Victoria) M.C.—An interesting visit was paid to the Moonee Creek Railway Viaduct, and members were able to inspect the track by four footways provided. Model-building meetings are held, and Hornby Train nights are well supported. Visits to places of interest, Rambles, Lectures, and Games appear on the programme, and a debate on "*Steam v. Electricity*" aroused keen enthusiasm. Club roll: 58. *Secretary:* F. G. Wallis, 2, Bellavista Road, Glen Iris S.E. 6, Victoria, Australia.



XXXVI.—BOAT TRAINS ON MINIATURE LAYOUTS

THERE is a good deal of romance attached to trains that run in connection with steamer sailings.

Few railway enthusiasts will watch the departure of such a train, bearing perhaps the legend "Boat Express" or "Ocean Liner Special," without conjuring up a vision of the scene at the quayside before the departure of the steamer, perhaps for a port in some remote corner of the globe. In the case of model railway owners an immediate result of a visit to a terminus and the witnessing of any special feature of railway working is a strong desire to carry out the same thing as far as possible on their own layout. No matter what group is represented by the miniature line, boat trains may be correctly operated, for many trains in connection with steamer sailings are run by all the four group companies. There is a wide choice also in the matter of ports, and therefore of the section of railway represented, so that most miniature railways will be able to include such trains in their working arrangements.

A boat express on a Hornby layout representing the L.M.S.R. The two tank locomotives are hauling the train over the section from the quayside to the main line. This reproduces the actual practice of the L.M.S.R. in Liverpool.

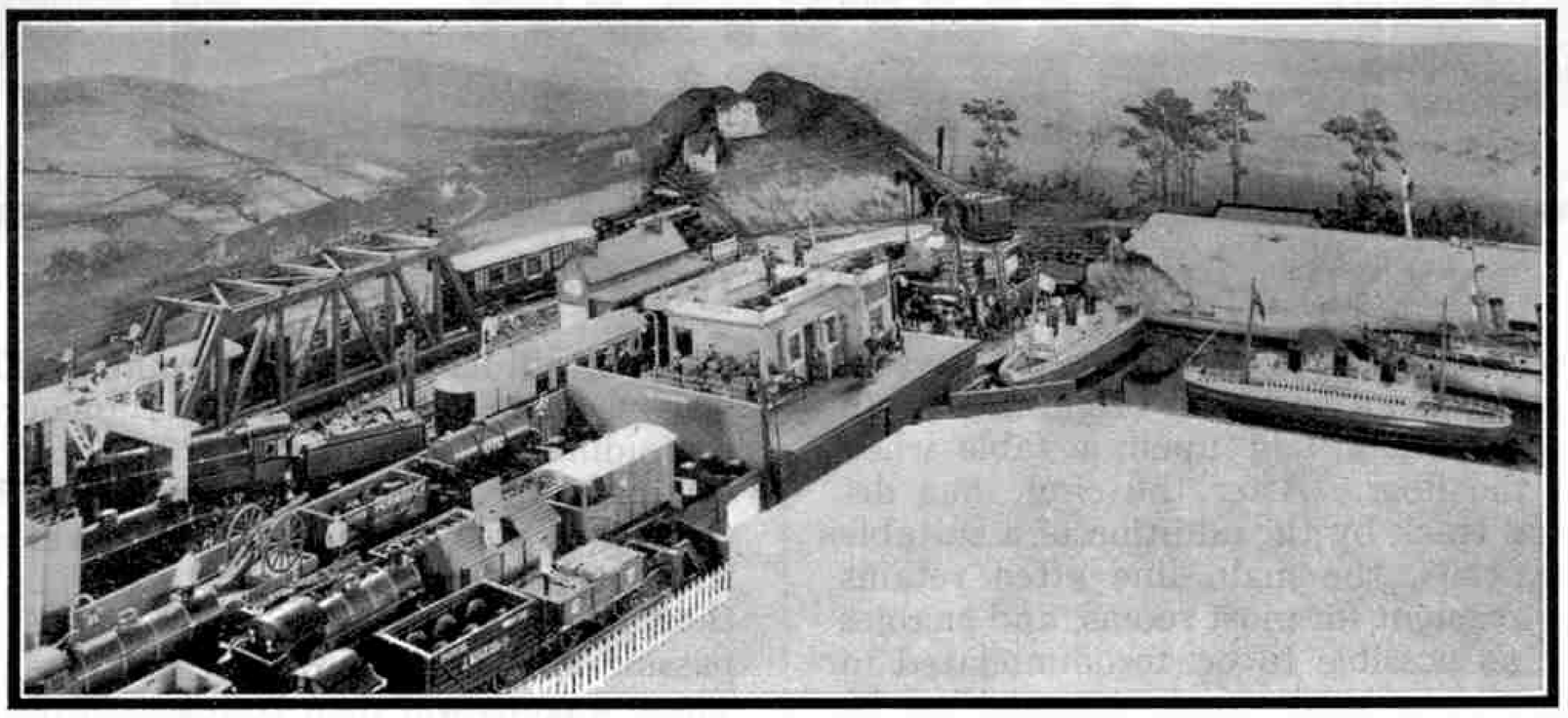
It would be of little use to run a boat train if there were no quayside or harbour station for it to run to. The scale on which this is provided, however, is entirely a matter for the railway owner to decide. It may be quite a simple affair of cardboard, or at the other extreme it may take the form of an elaborate installation such as that seen in the accompanying photograph of Captain Rodgers' harbour station.

In the case of continuous layouts—and these are most commonly used—a branch line may be led off from the main track and a harbour or quayside be situated at the end of it. The accommodation as regards sidings will probably be limited owing to space restrictions, but an effort should be made to include a line to enable the arriving engines to run round the train. If this is not possible, an engine road for a turnover locomotive should be included. The simplest arrangement will be for an ordinary platform to lie between the train and the steamers, and such a scheme may be put into practice in the minimum of space. A crane should be provided for the transhipment of luggage, and the Hornby Platform Crane may be pressed into service for this. In fact the Goods Platform, which has a crane mounted upon it, together with a building for the dealing with luggage, might be very well used, the building representing a Customs shed where such a feature is required. Hornby Passenger Platforms may be used to complete the rest of the quay, and one or two cardboard offices and buildings may be made up if desired and placed upon it.

We must now consider a most important part of the subject, for a boat train running to a harbour platform with no ship in sight would be out of the question. Where available, suitable model ships may be placed alongside the quay, and in order to give some depth to the scene an appropriate background should be incorporated if possible. To be really effective the ships have to be large, and few boys are able to obtain or build suitable models. Therefore we must cast about for some means of representing them. Most enthusiasts will be familiar with the posters issued by shipping companies, many of which show very fine representations in colour of some of the famous ocean greyhounds. These may be used very effectively, perhaps cut down a little at the bottom in order to give the

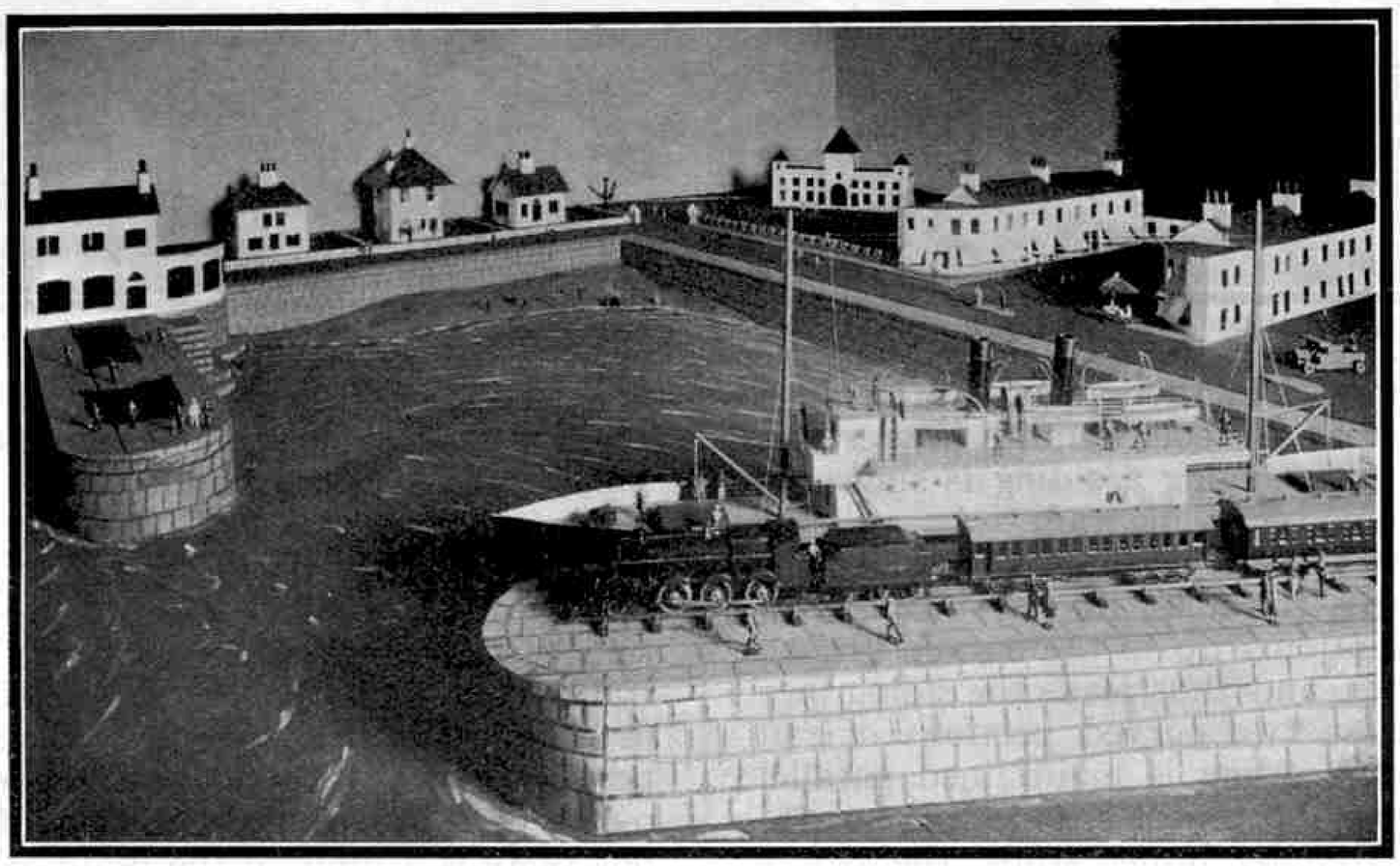
ship the appearance of being alongside the quay. If several different posters are available a fine composite scene with a number of different vessels may be made up. Shipping companies as a rule may be persuaded to part with one or two posters suitable for the purpose.

This method involves the minimum space, as the scenery may be placed against the wall with the quayside and railway lines close up to it. Boys who prefer to construct their own accessories may make up the quay and its buildings exactly as required in the particular situation.



A corner of the model railway of Captain Rodgers (H.R.C. 2259). The station shown is Dover Marine and boat trains connecting with Continental steamers are run regularly.

The actual composition of the boat trains will depend somewhat on the particular port represented and the traffic dealt with. For a miniature L.M.S.R. system on which Holyhead or Liverpool is represented, a train made up of No. 2 Saloon Coaches and hauled by a "Royal Scot" or Midland compound would be very appropriate, and would give a fine representation of an Irish mail train or an "American Boat Special" to Liverpool. As regards the latter it should be noted that the main line engines do not take the train the whole way to the quayside, owing to various restrictions. Boat trains are therefore stopped at Edge Hill just outside Liverpool and the main line engine is detached. Two small tank locomotives take its place and complete the journey through Waterloo Tunnel to Riverside Station. The same process in the reverse order is gone through on the return journey. This provides an interesting piece of working for reproduction in miniature, and one of the accompanying photographs shows two Hornby Tank locomotives at the head of a train emerging from a tunnel in much the same manner as their prototypes on the L.M.S.R., which have a quaint look of importance as the result of carrying express train headlights!

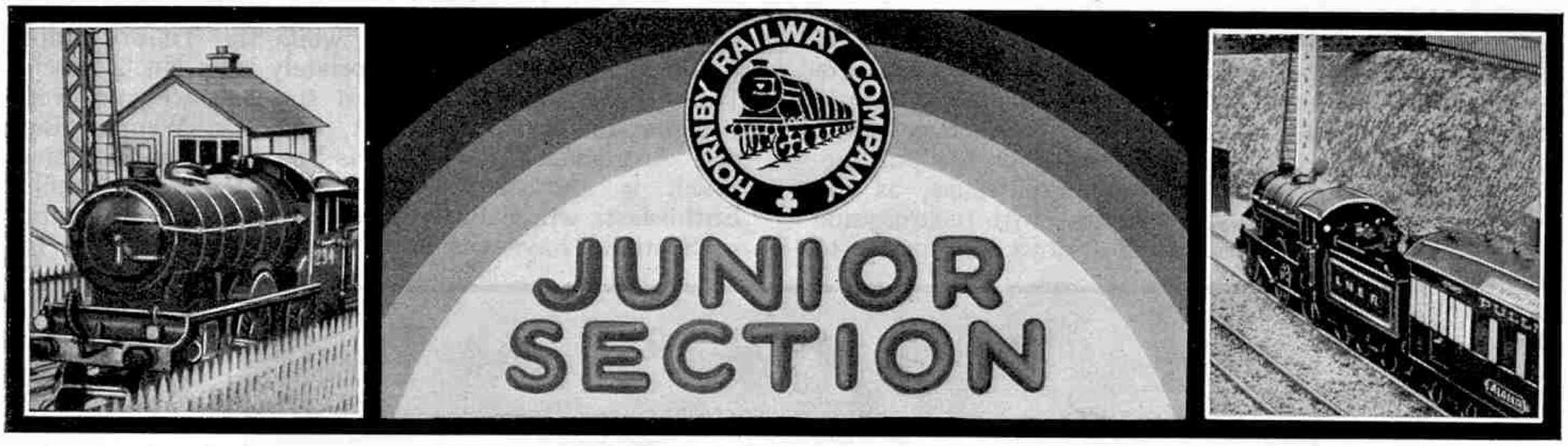


A miniature town and harbour served by a model railway. The liner looks extremely realistic alongside the quay and the boat express shown in the foreground has just arrived.

Among other places where L.M.S.R. trains meet the boats are Heysham for Ireland and the Isle of Man, and Tilbury for Dunkerque and elsewhere on the Continent. For the Heysham trains on a Hornby system the No. 2 Special L.M.S.R. Locomotive will be the right engine to use, while the Tilbury trains would be hauled more appropriately by a No. 2 Special Tank. Interesting boat train services are run from Glasgow to the Clyde Coast, Gourock, Wemyss Bay and Ardrossan, and there is in addition Stranraer, which is another L.M.S.R. port for Irish traffic. Enthusiasts whose lines represent the L.M.S.R. system in Scotland have therefore splendid opportunities for boat train operations upon their layouts.

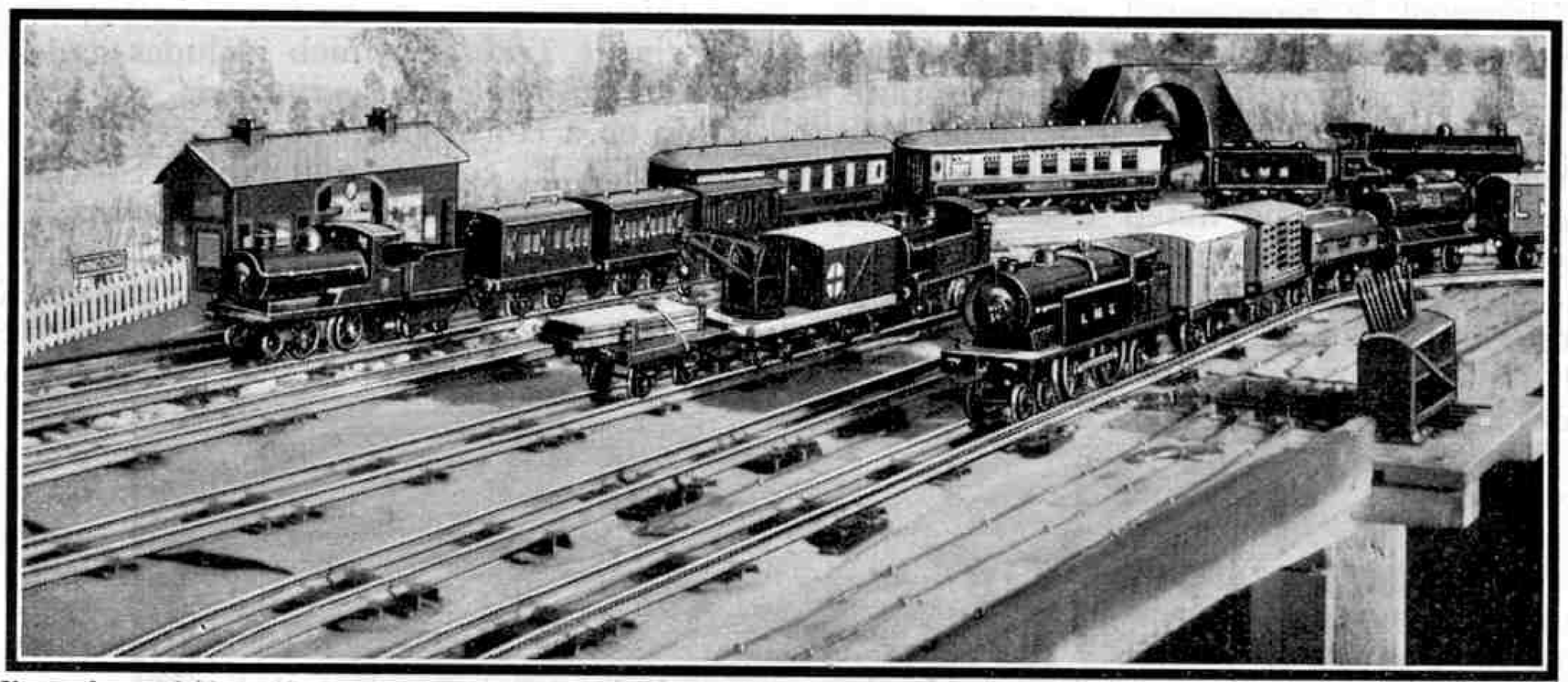
As regards miniature L.N.E.R. systems, the Harwich trains immediately suggest themselves. These run from Liverpool Street to Parkeston Quay, and are well known for the fine locomotive work involved. Many interesting details of this service are to be found in Mr. C. J. Allen's book *"Famous Trains,"* which includes a description of the *"Hook of Holland Continental."* The make-up of a train on a Hornby layout requires No. 2 Saloon Coaches in L.N.E.R. colours and No. 2 Special Pullman Cars, so that a miniature *"Hook Continental"* will present a very interesting appearance with the coaches vestibuled together. For the locomotive a Hornby No. 3 or No. 2 Special may be used in place of the "Sandringham" engine used in real practice. Those who wish to be up to date may take advantage of the fact that a new train was instituted this summer, called *"The Norseman."* This starts from King's Cross and runs to Newcastle in connection with steamers to Bergen. In addition to the Antwerp and Hook of Holland trains from Liverpool Street, there is also *"The Scandinavian"* express running in connection with the steamer for Esbjerg.

Great Western enthusiasts may not have a great deal of choice in the matter of boat trains, but the G.W.R. have acquired the reputation of giving American visitors a splendid taste of the quality of British railway speed in the journey between Millbay Docks, Plymouth, and Paddington. Mails are frequently landed at Plymouth and run up to London in record time by the well-known "Ocean Mail Specials." There are in addition boat trains to Weymouth, whence steamers (Continued on page 845)



XXXIV.—SIDINGS, LOOP LINES AND THEIR USES

THERE are probably very few miniature railways in existence that have not had their origin in a small circular or oval track laid upon a table when convenient, or on the floor. After the circle has developed into the oval track by the addition of a suitable number of straight rails, the main line often retains this form, as it is convenient for most rooms, and enables as much main line as possible to be accommodated in the space available. The next track material to be acquired will probably be points to enable the trains to be turned from one line to another, and to lead to loop lines upon which stations may be situated, or to sidings terminating in a goods yard or locomotive depot.



Six tracks are laid at this part of the layout of T. Spence, Johannesburg. The scenery is effective and the tunnel mouth in the background is very well arranged.

The mention of sidings and loops may seem elementary to some readers, but there are several points to be noticed in their incorporation in a layout, and the subject as a whole is quite interesting. The simplest method of arranging a siding is shown in Fig. A of the accompanying diagram. As will be seen, the siding is made up of several lengths of straight track, and turns towards the main line by means of a single curved rail. This joins up to the curved branch of the right-hand points, and thus leads the siding into the main line. As these two curved portions of rail balance one another, the siding is maintained parallel to the main line. It may be almost any desired length, and should be terminated by buffer stops, the No. 1 spring variety being the more suitable of the two patterns available in the Hornby Series.

Another simple scheme is shown in the diagram at B. At first glance it might be thought that this could hardly be useful in a layout, but nevertheless it is quite a good arrangement. It may be used by trains travelling in either direction upon the main line, and vehicles may be picked up or detached by these trains as required. Thus a train upon the main line approaching the points in a facing direction, and requiring to detach some wagons, will halt before the points. The engine and the wagons to be left will then be uncoupled and run into the siding, the chief portion of the train being left on the main line. The wagons will then be shunted off by the engine over the points, which will now be set for the straight road, perhaps up to the buffer stops. Here they are out of the way, and not likely to foul anything passing to and from the main line over the points. These wagons will then be ready in position to be picked up later by a train travelling in the same direction.

Similar operations may be carried out equally effectively by trains travelling in the opposite direction along the main line. Any wagons waiting to be taken up from the siding must be dealt with by the engine before the other wagons are left. Thus the engine and these latter wagons will leave the train and move those that are to be attached first; then the wagons for the siding will be shunted in.

These simple types of dead-end sidings will be quite sufficient at first if the layout is small and not much rolling stock is available. If the siding is used to refuge goods trains, or to store them while passenger traffic is dealt with, the length of these trains will be determined by the capacity of the siding. Where space permits it may of course be extended if longer trains are required owing to the addition of more rolling stock, but there is a limit to the usefulness of a long siding of this kind. Whichever direction it is to take on the main line, the goods train refuged in the siding will always have a tedious backing movement to perform, either in entering or leaving. This takes a considerable time where a long train is involved, and together with the fact that the main line is also partially occupied during the operation, may be the cause of delay to a passenger train for which the goods train is being refuged.

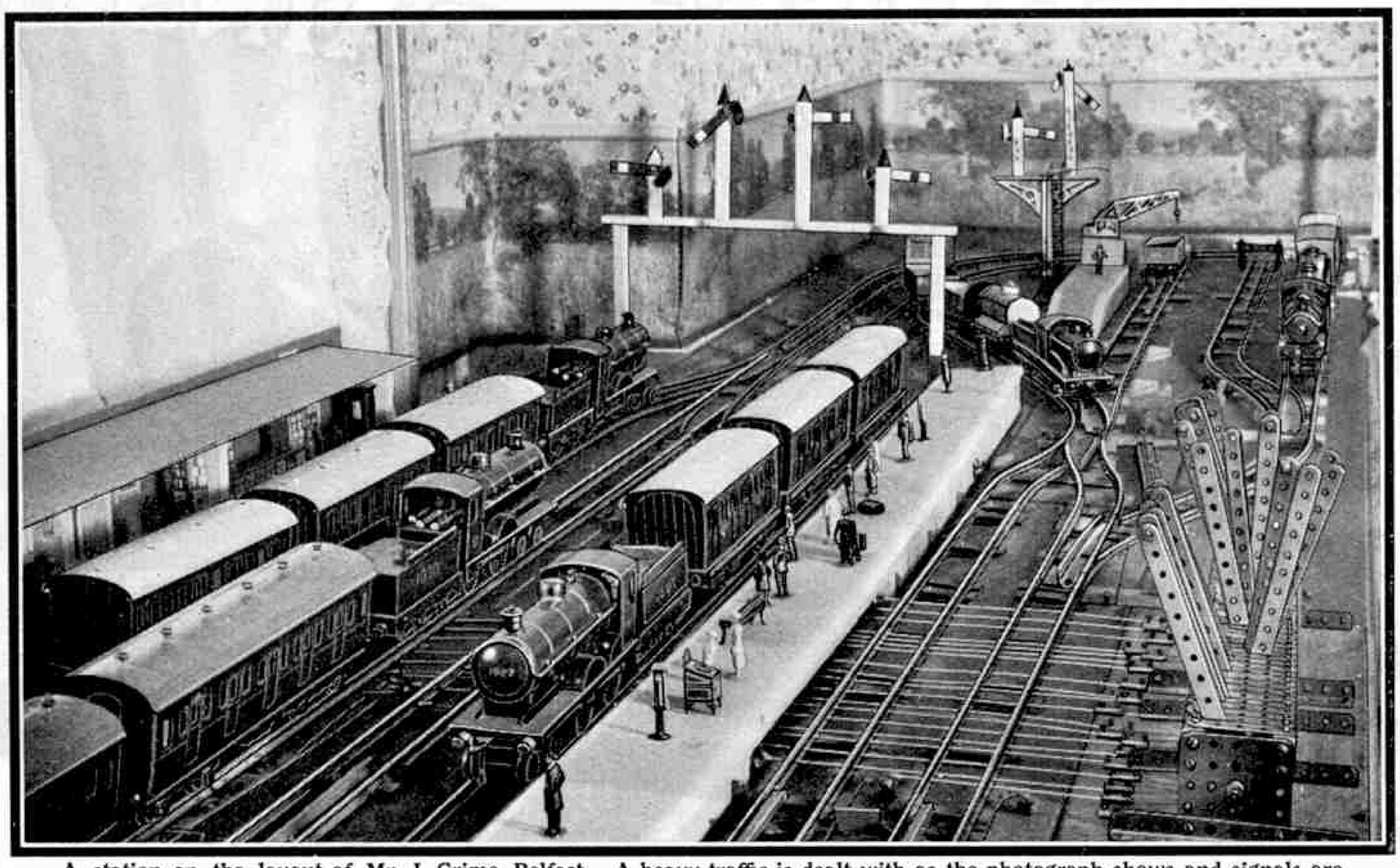
In order to avoid such delays the obvious step is to provide a connection to the main line at each end

of the siding, or in other words to convert it into a loop line. Its usefulness is greatly increased by the alteration, for trains in either direction are able to run in or out of the loop without trouble. Then again, if the loop is situated at a station, it provides the means for an engine to run round its train if necessary, and is much more convenient than a plain dead-end road, particularly if some vehicle at the farther end of the loop is required for immediate use upon the main line.

Such loops may readily be made up of Hornby Points and track material. Two points are necessary, one Right-Hand and the other Left-Hand, and two Curved Rails of the same radius as the Points will be required to bring the straight portion of the loop parallel to the main line. There is of course a fixed relation between the length of the straight portion of the loop and that of the main line between the points. The main line length between the points is longer by two Straight Rails, one Half-Straight Rail and one Quarter-Straight Rail, than the corresponding portion of the loop between the curved rails. This is clearly indicated in the diagram at C, where a loop line is shown. The main line portion consists of six Straight Rails, and the siding portion is therefore made up of three Straight Rails and one Quarter-Straight Rail.

Where possible loops are always to be preferred to dead-end sidings, as running may be continuous in the sense that no backing is required. A long dead-end road becomes a nuisance, but its value is greatly increased by converting it into a loop and so providing communication with the main line at both ends. Loop lines used on single-track layouts may either give the effect of double track where they are installed, or may give the choice of routes, as mentioned in the "*M.M.*" last month. They are employed very effectively in the layout of T. Spence of Johannesburg, a section of which is illustrated here. Six tracks are found at this point, giving a choice of three lines each way.

An arrangement that is almost invariably found in real practice is shown in the diagram at D. In this the loop has short extensions at each end, terminating in buffer stops. Thus the connections to the main line become in effect crossovers, and the loop shown is actually made up in this way. Usually this formation is adopted as a precaution in case a train entering the loop is unable to stop in time, and therefore may possibly foul the main line at the outgoing end of the loop. If this occurred on a loop with short extensions the main line would be left clear, as the points at the end towards which the engine was running would be set for the straight road leading to the buffer stops.



A station on the layout of Mr. J. Grime, Belfast. A heavy traffic is dealt with as the photograph shows and signals are controlled from a lever frame made of Meccano.

This scheme may perhaps be considered a luxury on a miniature system, although the effect is very realistic. At the same time the use of two crossovers for a single siding is rather out of the question for many model railway owners, and indeed the crossovers are not employed to the best advantage in such a situation.

Sometimes the extension of one end of a loop to a buffer stop in this manner is an advantage, as odd vehicles may be left there without interfering with the use of the loop by other traffic. Similarly a complete train may be left there if the siding is sufficiently long. A good example of this is found in the accompanying illustration of part of the layout of Mr. J. Grime of Belfast. Here a dead-end road serving a goods platform is led off from a main platform loop. Such an arrangement is of great value at the head of a terminal station, for odd vehicles may be detached from the rear of a train that has arrived, and may be backed into the buffer stop portion. In addition to this, "turnover" locomotives may be kept there while waiting for their next outward journey, instead of having to stand at the platform, where they will almost certainly be in the way of other traffic.

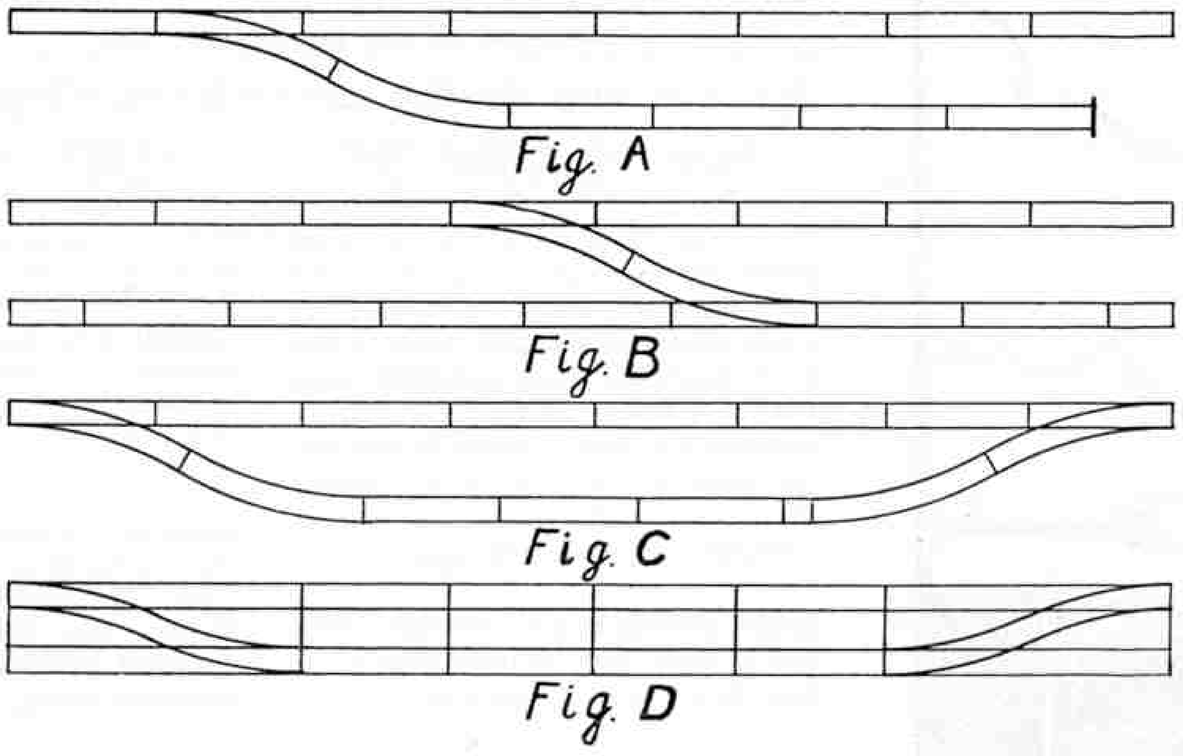
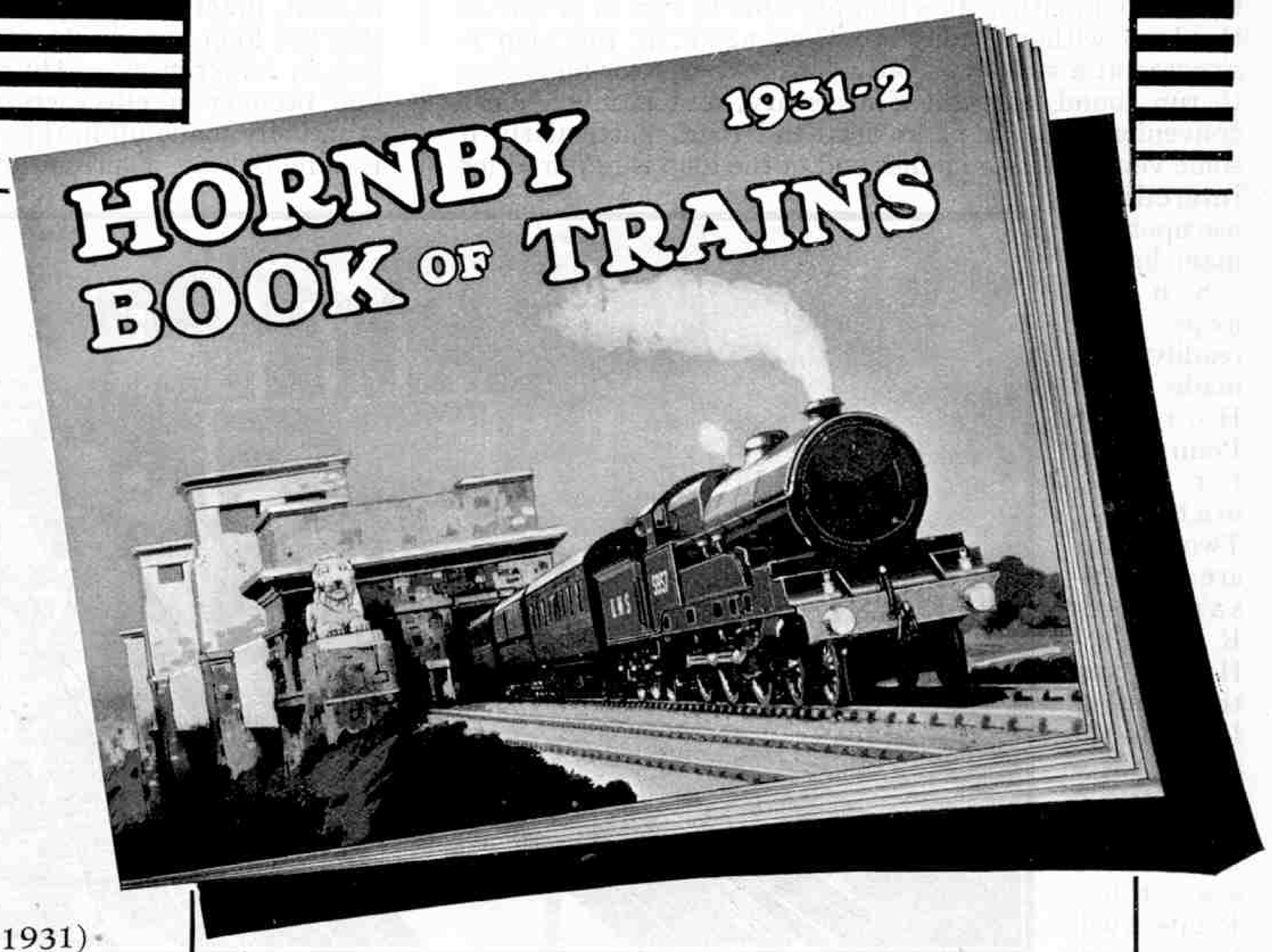


Diagram showing the various siding arrangements mentioned in this article.



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Branch Notes

HAROLD WOOD.—The Branch entered a decorated lorry in the Romford Carnival. The main feature was a layout in the form of a continuous oval, with passing loops on each side and a central goods yard, the vacant spaces being filled in with farm buildings, animals, etc. The lorry was awarded second prize, a silver cup, in the class in which it was entered. A debate on "*Electricity v. Steam*" was held, electricity receiving the most votes. Secretary: E. N. Tyler, 2, The Ridgeway, Harold Wood, Romford, Essex.

ILKESTON AND DISTRICT.—Extensive alterations to the Branch track have taken place and a new engine shed has been purchased. A Branch Library has been started, which at first is to be devoted mainly to railway books. Secretary: F. B. Caddick, "Woodthorpe," Catherine Avenue, Ilkeston.

HIPPERHOLME AND DISTRICT.—The Branch visited the local station, armed with notebooks and pencils. Locomotive numbers and other details were taken down, and members afterwards compared notes. A Library is being formed. The Branch railway is to be correctly signalled. Secretary: Sam Hoyle, The Hollies, Hipperholme, Halifax.

BOLSOVER AND DISTRICT.—A Lecture was given by the Chairman on "*Electric v. Steam Transport.*" He explained the advantages of electric trains for short suburban work, but concluded by saying: "I think we all prefer the steam locomotive, there is something human about the 'Iron Horse.'" Members heartily agreed that the end of the steam locomotive was yet far distant. A ramble of 12 miles was held, followed by tea and track operations. Secretary: John L. Lee, Mooracre Lane, Bolsover, Nr. Chesterfield.

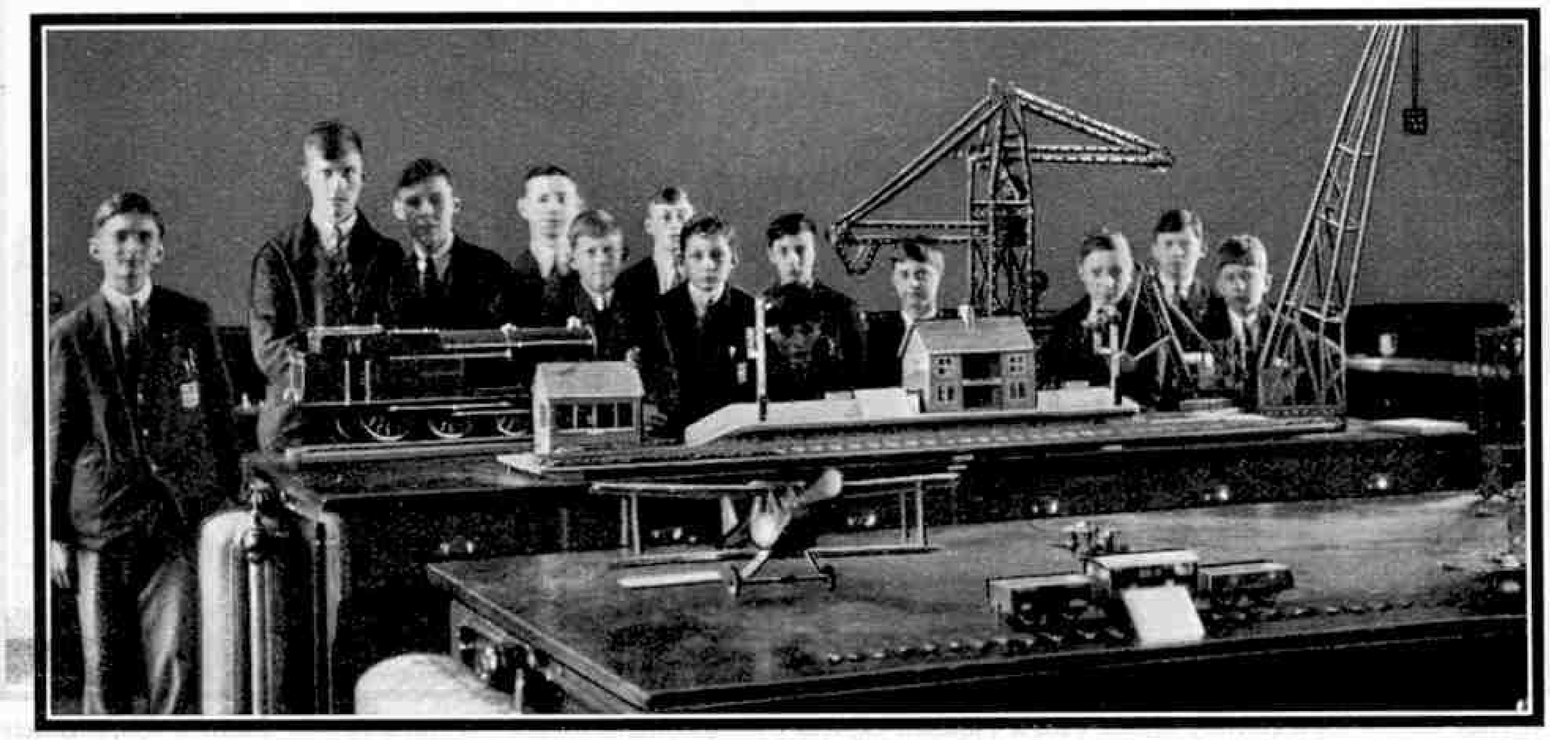
SOLIHULL.—A Model Railway Display was given in connection with the Solihull School by this Branch and the Olton (Birmingham) Branch. The interest of the visitors was so great that the members had some difficulty in operating the track owing to the great crowds round the layout. Several "Counties" that were busily employed were greatly admired. Indication boards for the "*Cornish Riviera*" express had been made, and the changing of the locomotive at Plymouth created quite a sensation. Meccano models loaned by Headquarters were also displayed. Secretary: H. A. T. Aitken, "Cardross," Broad Oaks Road, Solihull.

MARLBOROUGH (SOUTHPORT). — The Branch track, which is a very extensive one, has been carefully tested and the sleepers and rail-joints strengthened. The engine sheds at "Langdale Junction" have been completed. The members indulge in Badminton as a change from railway operations. A visit has been paid to Garstang to view the heavy holiday traffic. Secretary: G. R. Bartram, "Milestones," Blundell Drive, Birkdale, Lancs.

FIRST BOURNVILLE.—A great deal of experimental track work is being carried out. The most successful track laid down was a double-track horse-shoe shaped layout with two terminal stations and hump sidings. New shelves are being erected on trestles, and this track is to be screwed down and correctly signalled. Secretary: Lionel D. Hall, 11, Franklin Road, Bournville.

OLTON (BIRMINGHAM).—This Branch gave splendid help to the Solihull Branch in the recent demonstration held at Solihull School. An interesting visit was paid to the works of Morris Commercial Ltd., where great interest was shown in the grinding of the valves and assembling of the gear boxes. "Director," "Leader" and "Viceroy" vehicles were all seen in various states of manufacture. Members were given tea by the Manager. Secretary: J. T. Austin, "Stoneleigh," 58, Kineton Road, Olton, Birmingham.

EAGLEHURST (PALMERS GREEN).—Track meetings are held regularly every Thursday. Members have made many experiments with the suggestions that appear in the H.R.C. section of the "*M.M.*," and, according to the Chairman, try to improve upon them. A manuscript magazine has been compiled, which consists of 50 pages on all kinds of subjects. Secretary: R. J. Cotton, 236, Princes Avenue, Palmers Green, London, N.13.



Members of the Solihull and Olton Branches with a section of their demonstration layout, which was the centre of attraction at the recent display given in connection with Solihull School.

Branches in Course of Formation

The following new Branches of the Hornby Railway Company are at present in process of formation and any boys who are interested and desirous of linking up with this unique organisation should communicate with the promoters, whose names and addresses are given here. All owners of Hornby trains or accessories are eligible for membership and the various secretaries will be pleased to extend a warm welcome to all who send in their applications:

CARLISLE—C. Heaton Hammond, 66, St. James Road, Carlisle.

HEXHAM—J. B. Harris, 12, Giles Gate Bank, Hexham, Northumberland.

LITTLEHAMPTON—D. J. Allen-Williams, Beach Lodge, Littlehampton, Surrey.

SHOREHAM-BY-SEA—J. Bishop, "Silverton," Lower Beach Road, Shoreham-by-Sea.

STEVENSTON—M. Fitzpatrick, 15, Station Road, Stevenston, Ayrshire.

OVERSEAS

AUSTRALIA—Allan Dempster, De-Aar, King Street, Warwick, Queensland.

Further Incorporated Branches

193. SHEPHERDS BUSH—Hugh B. Moyer, 99, St. Stephens Avenue, Shepherds Bush, London, W.12.
194. HERNE HILL—John Nunn, 70, Herne Hill, London, S.E.24.

OVERSEAS

195. MANAWATU (N.Z.)—Robert Hall, 110, Albert Street, Palmerston, New Zealand.

Signal Cabins in the Hornby Series

By "Tommy Dodd"

ONE of the most familiar features that we see along the lineside during a railway journey is the unbroken chain of signal cabins. These cabins play a very important part in the elaborate system that the railways have developed in order to ensure the safety of passengers. A visit to a signal cabin is full of interest. The completeness of the safety system, and the quiet efficiency with which the man in charge carries out the successive operations involved, leaves an impression on the mind that is not easily lost.

In the early days of railways, signals and points were operated by men stationed alongside them. Sometimes several signals and points were under the control of one man, and he had to walk to each of them as required. These "policemen," as they were often called, were provided with shelter in the form of huts, and in these huts the present-day signal cabin may be said to have had its origin. As the amount of traffic increased it became more and more difficult for one man to control a set of signals and points by walking from one to another, and a great step forward was made when a system was developed by which several signals and points could be controlled from one central position. An apparatus for this purpose, introduced by Sir C. H. Gregory, was demonstrated in 1843 at the Bricklayers' Arms Junction on the old Croydon Railway, and its immediate success led to its adoption, with various modifications, by all British railways.

A wayside station on a Hornby layout with a Pullman express train passing through. A No. 2 Special Cabin is appropriately placed at the platform end.

Signal cabins vary greatly in size and type, according to the work they have to perform. At important stations and junctions there are large cabins where power operation is installed and several hundred levers are controlled; while at the other extreme are the wayside cabins, simply built, and housing perhaps a bare dozen levers. Various methods of construction are employed. Some cabins are built entirely of timber, more or less ornamental in style; while others consist of a brick lower portion in which the locking gear is installed, with a timber upper part above the floor, where the lever frame is situated. A noticeable feature of signal cabins is the large proportion of window space, for a good view of the operations carried out under his care is essential to the signalman.

The upper part of the cabin is reached from the ground by a flight of stairs, and sometimes, as an extension to the "landing" at the top, a gallery is run along the sides of the cabin in front of the windows. This gallery is particularly useful where the manual exchange of staffs for single-line working is carried out. It also enables the signalman to be in closer contact with any special shunting movements that may be necessary, as he can give warnings or instructions better from the gallery than through the windows of the cabin.

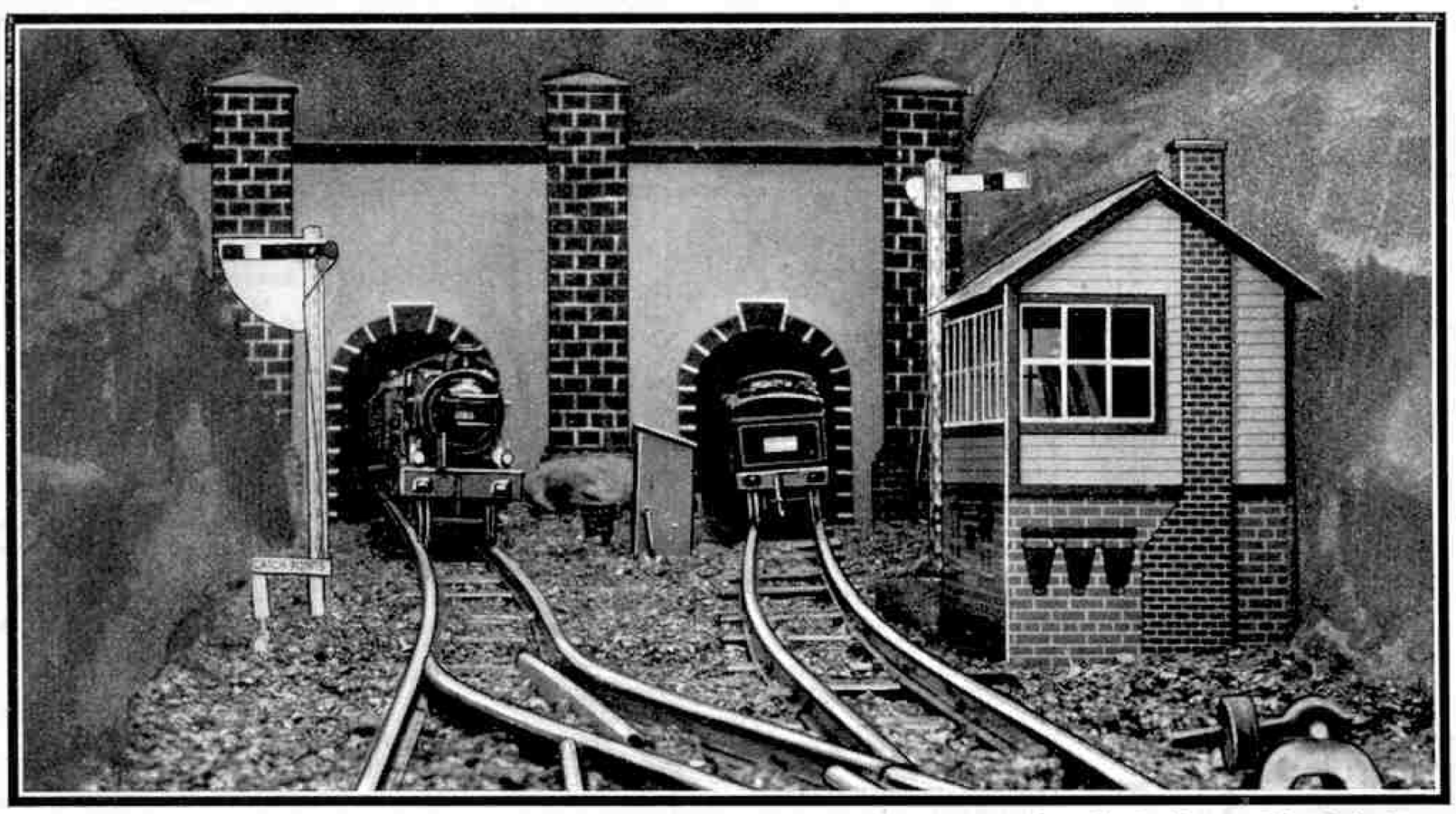
Chimneys of various patterns are provided for the cabin stove, a store of fuel for which is always found at the bottom of the stairway, either in a bin made of old sleepers or in one built of brick.

In addition to the normal cabins built on the ground at the side of the line, or placed on station platforms, there are many that have unusual situations. In the neighbourhood of towns, where the railway often runs between retaining walls, there may not be any space for a cabin alongside the line. In such cases the cabin may be built into the wall, and reached by a stairway running through the locking chamber. Another scheme that is frequently employed is to have the cabin spanning the tracks and supported on girders. A good example of this type of cabin is found at Waterloo Station on the Southern Railway, and there are many more in various parts of the country. Other curiously placed cabins are those on the various London underground railways, and in contrast to these subterranean chambers are cabins situated at quite high altitudes, especially in Scotland. One may be many feet below the London streets; the other, such as Beattock Summit cabin on the L.M.S.R., 1,000 ft. or so above sea level.

There are three different signal cabins available in the Hornby System, the No. 1, the No. 2 and the "M" Series Cabin. All three are of the station or wayside cabin type, and they are finished to represent one with a brick locking chamber and a timber upper portion with a tiled roof. The No. 2 Cabin is the most important model, and therefore will be considered first. This Cabin is finished by the tin-printing process, which allows a maximum amount of realistic detail to be represented. Thus the brick portion of the Cabin stands out clearly,

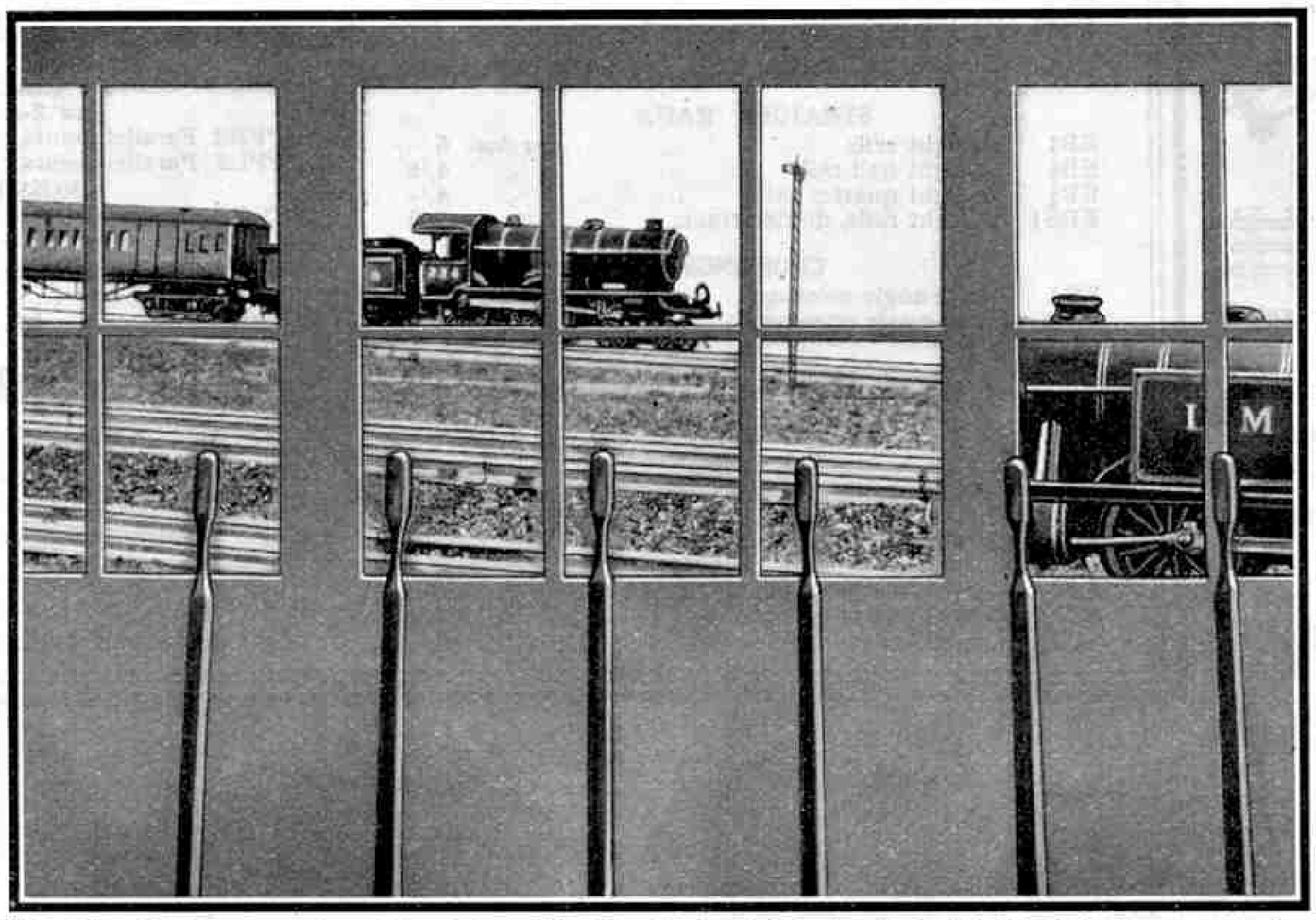
and at the front of this lower part there are two imitation windows. At one end a rack with fire buckets is shown, and there is a course of bricks passing up to the roof and representing a chimney. A neat chimney stack and pot are mounted on the roof itself, providing the finishing touch of realism on top.

At the opposite end of the building there is an effective stairway protected by a solid railing, and at the head of the stairs in front of the panelled door is a neat landing. Below this a plain boarded door is shown, leading to the locking chamber. The representation of the wooden part of the Cabin is attractive, with main frames and timbers finished in a dark colour, and the ordinary boarding in a lighter tint. The windows at the front and ends of this Cabin are actually pierced, so that the interior can be seen.



The fine details common to the Hornby Signal Cabins are well shown in this photograph. Single-line working is in force through the tunnel as a "Work Train" is occupying one line. The approaching express is about to cross over to the correct track.

A floor divides the upper and lower portions of the Cabin, and this has a large opening in the centre to accommodate the Lever Frame of the Hornby Control System. To enable the levers to be handled conveniently the back portion of the roof is hinged at the ridge, and may be lifted up, while the upper half of the rear of the Cabin opens downward. There is an opening arranged at the bottom of the front wall of the Cabin to enable the levers to be connected to the bell cranks situated before the frame outside the Cabin. The Lever Frame and bell cranks are mounted on a large base, to which the Cabin also may be attached. Small lugs are formed in front of the Cabin at each end, and a flange extends along the back. These are pierced to take the standard Meccano bolts with which the Cabin may be secured to the base.



What the signalman sees from his cabin. The Hornby Control System is installed and the levers operating signals and points are plainly visible.

The No. 1 Signal Cabin is generally similar in design, but lacks certain refinements that are found in the No. 2 model. It is not fitted to accommodate the lever frame, and therefore no lugs or flanges are provided for screwing it down. The windows are not pierced, but they and the stairway are represented in a very realistic manner in the tin-printing.

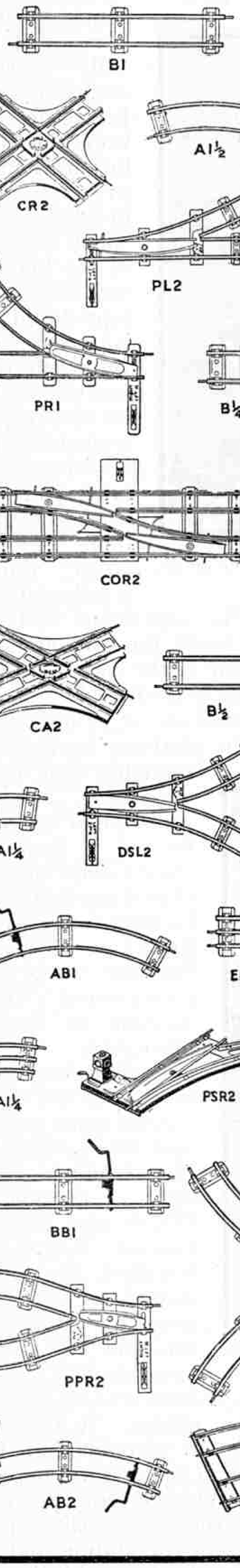
The "M" Series Cabin is a splendid little building, specially designed to be in keeping with the generally simple characteristics of the "M" trains and accessories. In order to keep the price low it is made as a "half model," in which the front of the building and the roof is reproduced. It is nevertheless very effective, and the printed details are quite realistic. The characteristic brick and timber construction of the larger Cabins is followed, and the colours are attractive. The signalman and the levers he controls are shown through the windows, and the door and stairway also appear at the end.

In addition to its use in conjunction with "M" trains, the "M" Cabin may also be used on larger layouts in such situations as on a station platform against the retaining wall, or in a cutting between walls where space is limited. Two of these Cabins may be placed together, back to back, in order to form a complete building, and used to represent a small wayside or branch line cabin.

Each station on a layout should have a signal cabin near it, and the position of this should be carefully considered. Where the Hornby Control System is installed, the cabin should be easy of access to the operator, and yet at the same time it should allow the supposed miniature signalman a clear view of the station and yard under his charge. A terminal station may require two cabins to accommodate the necessary levers, and the position of the two will depend a great deal upon circumstances. Where several operators are normally available to work the layout, the cabins may be placed on opposite sides of the station and be called "No. 1" and "No. 2" or "East" and "West."

GAUGE O — ALTERNATE PEGS

RAILS, POINTS & CROSSINGS



Hornby Rails, Points and Crossings are designed to meet the most exacting requirements of model railway enthusiasts. They make possible an almost endless number of realistic and railway-like layouts. Only the finest materials are used in their manufacture.

Rails for Clockwork and Steam Trains

CURVED RAILS

9-in. radius (For M0 Trains)

M9	Curved rails	doz.	3/–
MB9	Curved brake rails	each	3½d.

1-ft. radius

A1	Curved rails	per doz.	4/6
A1½	Curved half rails	„	3/6
A1¼	Curved quarter rails	„	3/–
AB1	Curved brake rails	each	6d.

2-ft. radius

A2	Curved rails	per doz.	4/6
A2½	Curved half rails	„	3/6
A2¼	Curved quarter rails	„	3/–
AB2	Curved brake rails	each	6d.
DC2	Curved rails, double track ...	½ doz.	7/6

STRAIGHT RAILS

BM	Straight rails (for M0 Trains) ...	per doz.	2/9
B1	Straight rails	„	4/–
B½	Straight half rails	„	3/–
B¼	Straight quarter rails	„	2/6
BB1	Straight brake rails...	each	5d.
BBR1	Straight brake and reverse rails ...	„	1/6
DS1	Straight rails, double track ...	½ doz.	6/6

DOUBLE SYMMETRICAL POINTS

For 1-ft. radius curves

DSR1	Double symmetrical points, right-hand	per pair	5/–
DSL1	Double symmetrical points, left-hand		

For 2-ft. radius curves

DSR2	Double symmetrical points, right-hand	per pair	5/–
DSL2	Double symmetrical points, left-hand		

PARALLEL POINTS

PPR2	Parallel points, right-hand... ...	per pair	5/–
PPL2	Parallel points, left-hand		

CROSSINGS

CA1	Acute-angle crossings (for 1-ft. radius tracks)	each	2/–
CA2	Acute-angle crossings (for 2-ft. radius tracks)	„	1/9
CR1	Right-angle crossings (for 1-ft. radius tracks)	„	2/–
CR2	Right-angle crossings (for 2-ft. radius tracks)	„	1/9

CROSSOVER POINTS

COR2	Crossover points, right-hand	per pair	12/–
COL2	Crossover points, left-hand		

POINTS

9-in. radius (For M0 Trains)

MR9	Right-hand points	per pair	3/–
ML9	Left-hand points		

1-ft. radius

PR1	Right-hand points	per pair	4/–
PL1	Left-hand points		

2-ft. radius

PR2	Right-hand points	per pair	4/–
PL2	Left-hand points		
PSR2	Points on solid base, right-hand ...	per pair	8/6
PSL2	Points on solid base, left-hand ...		
RCP	Rail connecting plates	½ doz.	2d.

Rails for Electric Trains

CURVED RAILS

1-ft. radius

EA1	Curved rails	per doz.	6/6
EA1½	Curved half rails	„	4/6
EA1¼	Curved quarter rails	„	4/–

2-ft. radius

EA2	Curved rails	per doz.	6/6
EA2½	Curved half rails	„	4/6
EA2¼	Curved quarter rails	„	4/–
EDC2	Curved rails, double track ...	½ doz.	9/–

STRAIGHT RAILS

EB1	Straight rails	per doz.	6/–
EB½	Straight half rails	„	4/6
EB¼	Straight quarter rails	„	4/–
EDS1	Straight rails, double track ...	½ doz.	8/6

CROSSINGS

ECA	Acute-angle crossings	each	4/–
ECR	Right-angle crossings	„	4/–

POINTS

For 2-ft. radius curves

EPR2	Right-hand points	per pair	7/6
EPL2	Left-hand points		

DOUBLE SYMMETRICAL POINTS

For 2-ft. radius curves

EDSR2	Double symmetrical points, right-hand ...	per pair	8/6
EDSL2	Double symmetrical points, left-hand		

PARALLEL POINTS

For 2-ft. radius curves

EPPR2	Parallel points, right-hand	per pair	8/6
EPPL2	Parallel points, left-hand		

CROSSOVER POINTS

ECOR2	Crossover points, right-hand	per pair	24/–
ECOL2	Crossover points, left-hand		
TCPL	Terminal connecting plates (low voltage)	each	1/6

Electrical Points for 1-ft. radius curves are not supplied

Centre Rails for Converting Ordinary Track to Electrical

CURVED CENTRE RAILS

1-ft. radius

AC1	Curved centre rails	per doz.	1/–
AC1½	Curved centre half rails	„	9d.
AC1¼	Curved centre quarter rails ...	„	6d.

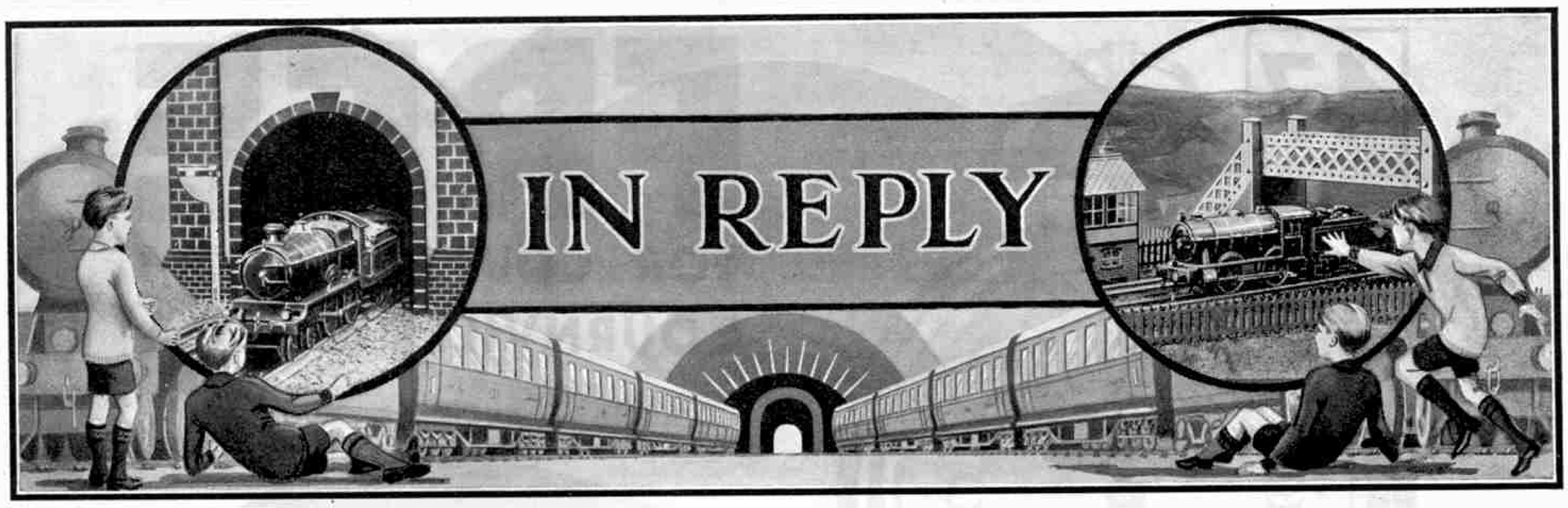
2-ft. radius

AC2	Curved centre rails	„	1/–
AC2½	Curved centre half rails	„	9d.
AC2¼	Curved centre quarter rails ...	„	6d.

STRAIGHT CENTRE RAILS

BC1	Straight centre rails	per doz.	1/–
BC½	Straight centre half rails	„	9d.
BC¼	Straight centre quarter rails ...	„	6d.
ICR	Insulators for insulating centre rails	„	3d.
CCR	Clips for fixing centre rails... ...	„	6d.

Manufactured by - - MECCANO LIMITED - - OLD SWAN - - LIVERPOOL



Suggested Hornby Train Improvements

IMPROVING THE RUNNING OF ROLLING STOCK

One of the most enjoyable features about Hornby Rolling Stock is the ease and smoothness of its running, as a result of which surprisingly long and heavy trains can be hauled by any of the locomotives. It is possible to secure even better running, however, by fitting Mansell wheels, or wheels of the cast spoked type used on "Special" tenders, in place of the ordinary wheels. In addition to giving steadier and smoother running these wheels improve the appearance of a train very considerably.

Ordinary 4-wheeled goods wagons should have the spoked wheels but for vans used in fast traffic and for bogie vehicles the Mansell wheels are more suitable. It is quite easy to remove the original wheels and insert the new ones in position between the frames. At the backs of the tin wheels will be found little washers, and it is a good plan to place these washers between the die-cast wheels and the bearings.

A still greater improvement in running may be effected in the case of wagons fitted with the new standard base by the addition of axle boxes. These boxes are provided with lugs to enable them to be clipped to the axle guards. When they are used, the little washers just mentioned are not necessary as the boxes themselves prevent excessive side play. If these boxes are packed with a light grease, such as vaseline, the smooth running of the vehicles is really remarkable, and very little further attention in the way of lubrication is required.

As there appears to be some doubt in regard to obtaining these wheels we take this opportunity of stating that both the Mansell wheels and the cast spoked wheels may be obtained at the price of 4d. per pair. The axle boxes cost 6d. per dozen. All three may be obtained from any dealer or direct from Meccano Limited, but in the latter case postage will be extra, amounting to 2d. for two pairs of wheels and 1½d. for a dozen axle boxes.

OIL FUEL TENDER FITTINGS

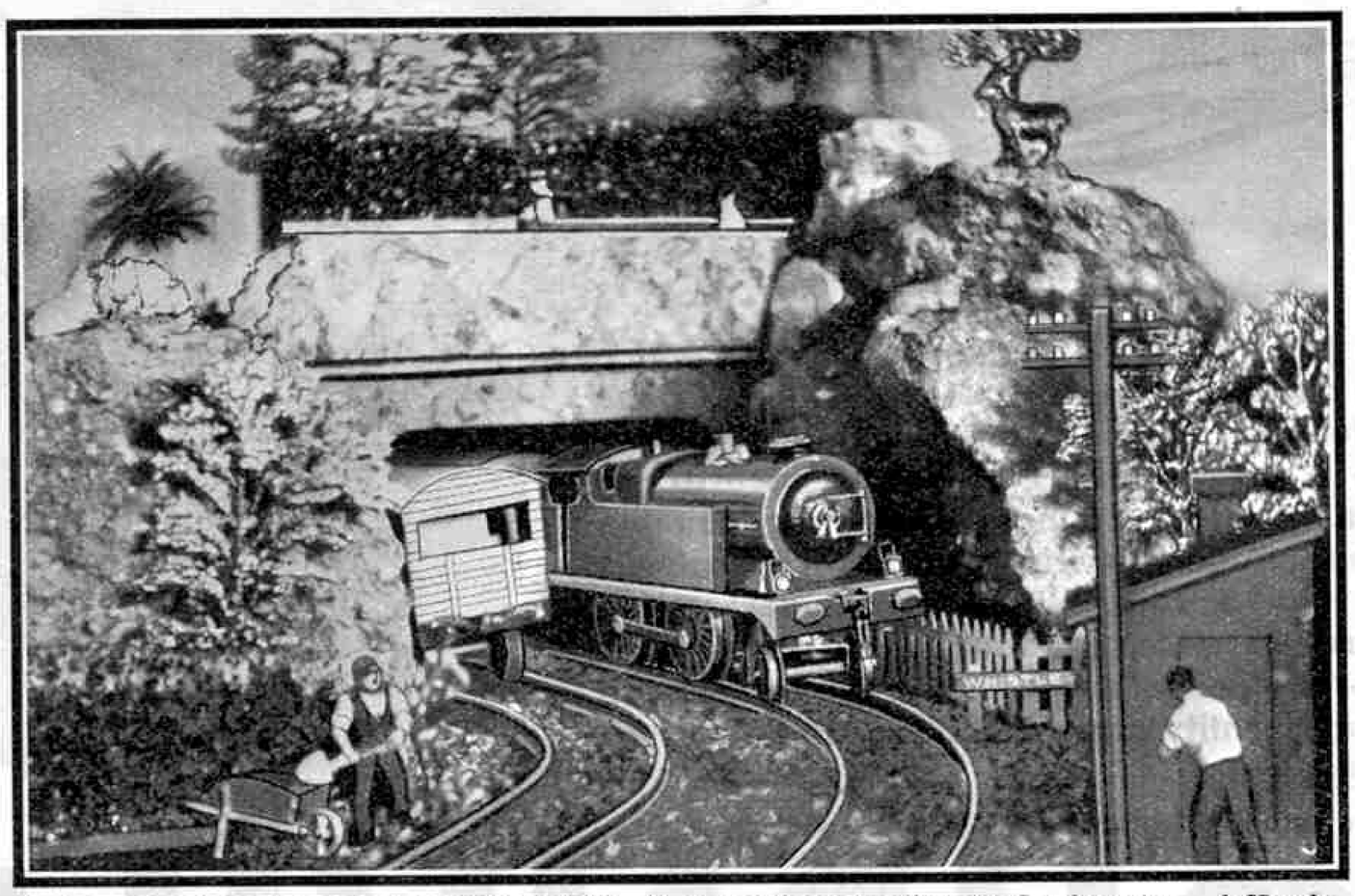
From time to time small numbers of British locomotives have been fitted to burn oil instead of coal, either for the purpose of experiment or to make up for deficiencies of coal supply during a strike. On the American Continent of course, oil is used as a locomotive fuel to a very large extent and enormous tank tenders have been developed to carry the supplies necessary for long journeys. Many H.R.C. members have suggested the introduction into the Hornby System of tenders of the oil tank type, but although we agree that these would be attractive in appearance, the type is so little known in this country that we do not think it would be very popular. As an alternative we suggest that readers should convert their own tenders.

In British locomotives that have been converted to oil burning, oil containers are invariably fitted in the coal space above the water tanks and their size and shape depends to a large extent upon the particular type of tender. A rectangular tank is easy to make out of cardboard fixed with seccotine and afterwards painted black. In the L.N.E.R. and G.W.R. No. 2 Special Tenders this tank may rest upon the tanks around the coal space; for L.M.S.R. and S.R. Tenders a special support will be needed, as the water tanks slope towards the front. In No. 1 Special Tenders the oil tank will rest upon the flat top of the tender. A filling cap for the tank may be represented by the top of a tooth paste tube. Circular containers either two placed side by side or two side by side with a third on top may also be made of cardboard without much difficulty.

FITTING AUTOMATIC COUPLINGS

Few developments in the Hornby Railway series have aroused such interest as the recent introduction of automatic couplings. We have had large numbers of enquiries as to whether these couplings can be obtained separately for fitting to Hornby vehicles with the non-automatic type of coupling. We are glad to be able to state that this can be done without difficulty. The automatic couplings are available separately at 3d. each, the postage being 1½d. for two couplings. The eyelet for attaching the couplings to the vehicle is included so that the fitting is quite a simple matter.

First of all the eyelet of the original coupling must be removed. In order to do this the wagon should be turned upside down and pliers used to pinch together the spread portion of the eyelet which will then fall out. This and subsequent operations will be made much easier if the wagon wheels are temporarily removed. The new automatic coupling is now put in position, and the new eyelet slipped through from the inside. The head of the eyelet inside the wagon should then be supported upon some hard surface and the part projecting through the coupling spread out by means of a small hammer. In order to prevent the assembly from binding a drop of oil should be put on the coupling and eyelet before finally riveting up. An alternative method of fitting the coupling is by means of a pivot formed of a Meccano bolt with two lock nuts.



A picturesque tunnel mouth on the layout of Mr. W. G. Bosley of Nursling, Nr. Southampton. A Hornby No. 2 Special Tank Locomotive is emerging from the tunnel while the tail of a goods train is disappearing from view. The scenic details are worth careful examination.

SHUNTER'S WAGON.—This type of wagon is seen in most goods yards and dock sidings where much shunting is carried out. The designs vary considerably, so that the reproduction in miniature of any one type would hardly prove sufficiently popular to warrant the expense of manufacture. We think that you will find the recently introduced Fibre Wagon without its load is an excellent substitute. Railings may be imitated by tying cotton round its stanchions, and the box sometimes found on these wagons, for chains, ramps and other gear may be made of cardboard. Many readers are using these wagons for this purpose with perfect success. (*Reply to L. Tipler, Tipton, Staffs.*).

"M" DISTANT SIGNALS.—We were interested in your suggestion that "M" distant signals shou be introduced to be used in conjunction with the present "M" home signal. Many similar schemes have been proposed for junction signals and gantries in the series. It is apparent that the "M" Signals are very popular, and we are therefore considering a number of additions to this series. (*Reply to J. R. Cooper, Swaffham, Norfolk*).

COAL OFFICE.—Model railway enthusiasts who make a feature of coal and mineral traffic on their layouts would probably appreciate a miniature coal office such as you suggest, and we have had such an accessory in mind for some time. Meanwhile, we suggest that you should use the existing Platelayer's Hut, with a suitable signboard added to the roof. (*Reply to S. Miller, London, E.15*).

FISH VANS.—You will be pleased to hear that designs are prepared for various new vans, and among them is included a fish van such as you suggest. As soon as these are available, announcements will be made in these pages. "Perishable" trains may then be correctly represented on Hornby railways. (*Reply to S. Miller, London, E.15*).

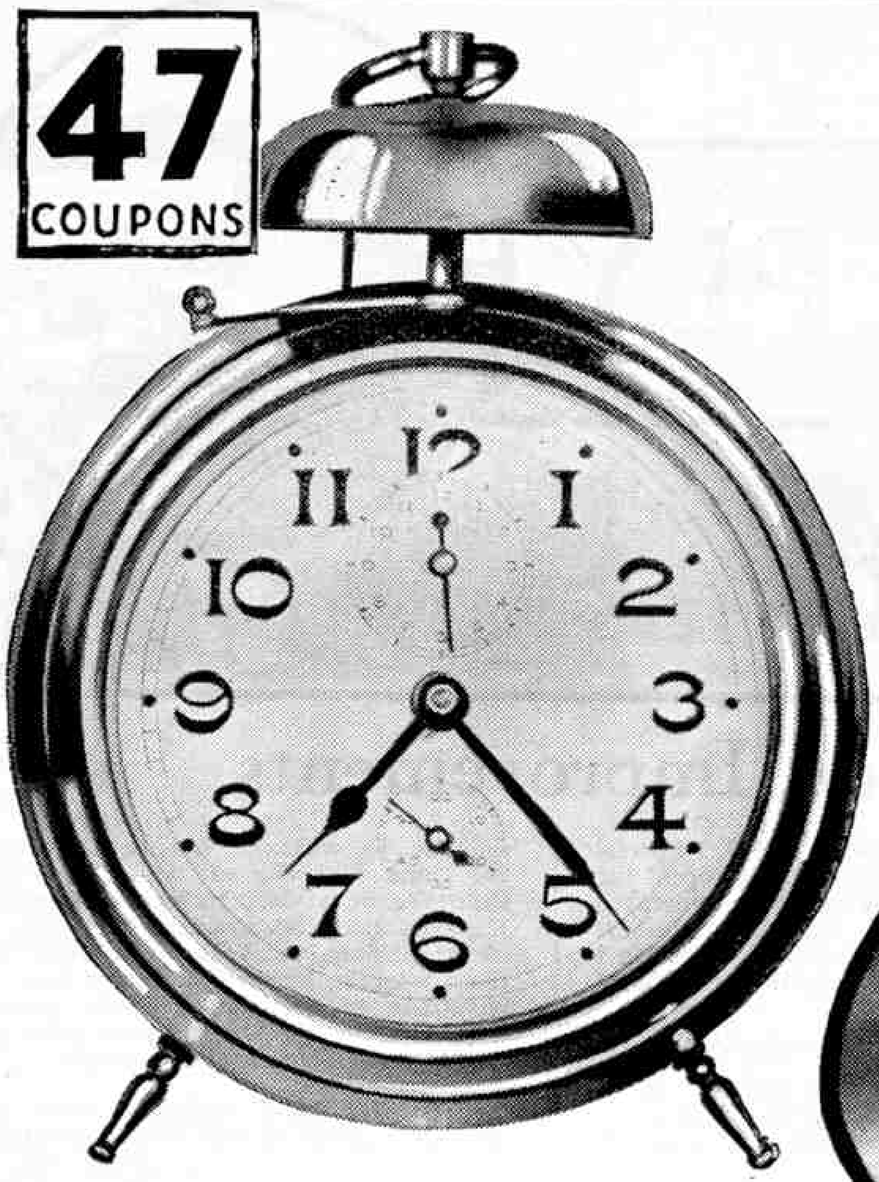
FLYOVER JUNCTION.—The construction of a flyover junction may easily be effected with existing Hornby track. The ascending line should be laid on a board, and the gradual slope of this arranged by supports made of Meccano parts placed at intervals. The sloping sides of the embankment may be imitated with brown paper suitably treated to represent either an earth or a cinder embankment. We agree that the introduction of a complete flyover junction would hardly prove popular not only because of the high cost, but also on account of the limited application in miniature of such a feature owing to the restrictions of space. (*Reply to J. Holgate, Forest Hill, London*).

RED PAINTED DETACHABLE TAIL LAMPS.—Where red tail lamps are specially required it is a simple matter to obtain a small quantity of red enamel and paint over the existing headlamps. These may be obtained separately, price 1½d. each. At present we cannot consider the production of red lamps, but brackets for their attachment to suitable vehicles are having our attention. (*Reply to F. Morris, Lancaster*).

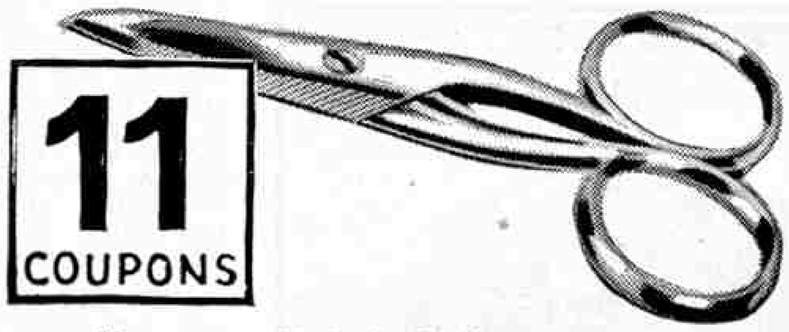
BANANA VANS.—You will be pleased to hear that we are now manufacturing a model banana van. This is enamelled in an attractive yellow and is transferred with the well-known name of "Fyffes." The new vans are now obtainable from any Hornby Train dealer, price 3/–. They are fitted with the new automatic couplings. (*Reply to J. E. Fernley, Northallerton*).

FREE

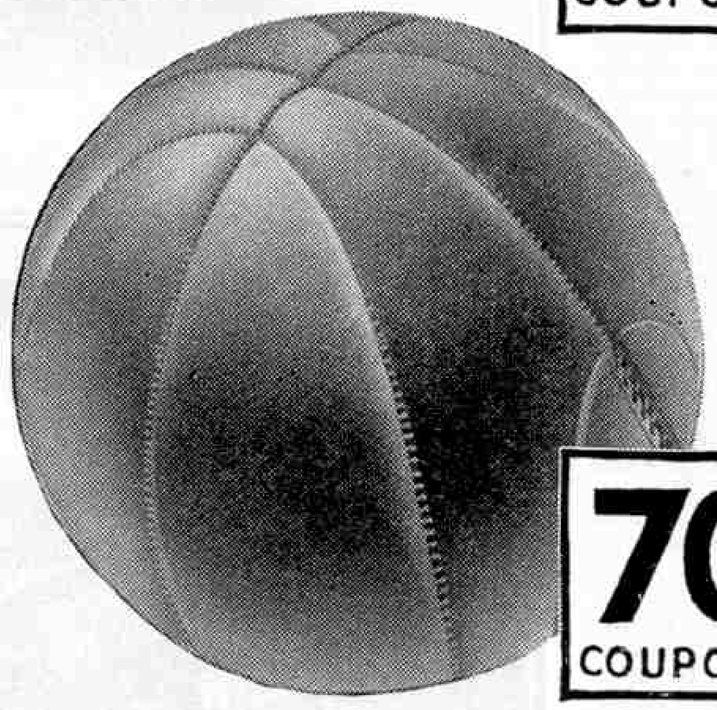
FOR COUPONS FROM BOURNVILLE COCOA



15 COUPONS



11 COUPONS



70 COUPONS

Here are just 4 of the 140 varieties of gifts which Cadburys are posting off each day to Bournville Cocoa users. The full-size, 8-panel British-made football for 70 Bournville Cocoa coupons breaks all records for coupon values. Then 47 coupons only bring you the copper-finished, 30-hour alarm clock. 15 coupons entitle you to select a 10in. Edison Bell 'Winner' record from the latest list which Cadburys will forward on request. For the pair of forged steel nail scissors you send the trifling quantity of 11 coupons. Could you ask for a quicker gift!

N.B. Write for complete list of gifts to 'New Gifts,' Cadbury, Bournville.

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Address your envelope to:
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½d. Stamp sufficient if envelope unsealed.
PLEASE SEND ME, POST FREE, THE CATALOGUE OF THE NEW BOURNVILLE COCOA GIFTS and FREE COUPON.

A 113

NAME .....
(IN BLOCK LETTERS)

ADDRESS .....

COUNTY .....

.....

This scheme applies to the United Kingdom and not to the Irish Free State.

H.R.C. COMPETITION PAGE

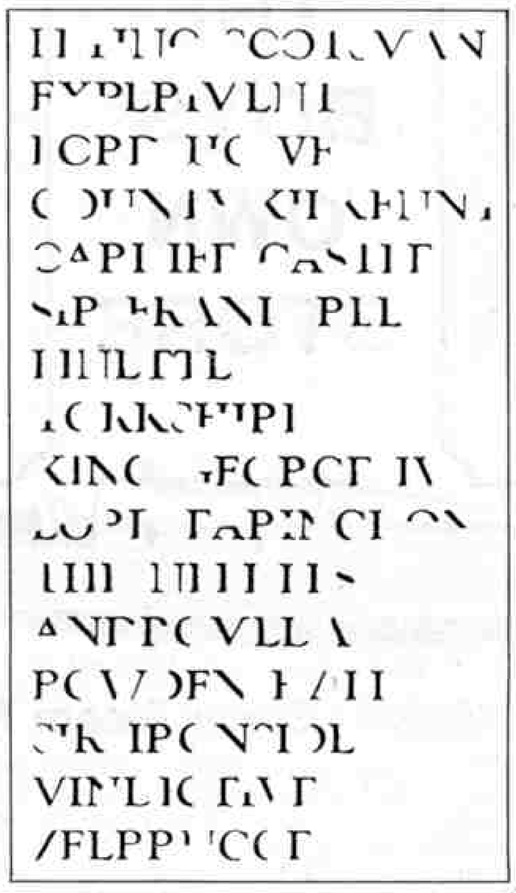
Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries, should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Binns Road, Old Swan, Liverpool. The name, address and membership number of each competitor should appear in clear writing on every sheet of paper used.

MUTILATED NAMES CONTEST

H.R.C. members have by now become familiar with the various locomotive name and number contests that have appeared from time to time on this page, and for which the number of entries received has always been particularly good. On account of the popularity of these contests we think that the one presented this month will be welcomed by members. In this we are approaching the subject in a different manner, which will give competitors a good chance to exercise their detective abilities!

In the centre of this page there appears what might seem at first glance to be Greek letters gone wrong! The sight of these will, we hope, puzzle the most seasoned locomotive name-collector, and the entries received will show how far we are correct. Actually there are 16 locomotive names concealed in the list and these include well-known named engines from each of the four great railway groups. The task before competitors is to puzzle these names out, and we think that members will be keen to decipher them.

Competitors are required to write down the names of the locomotives in the same order in which they appear in the panel, and in each case to state the group to which the locomotive belongs, its number and its wheel arrangement. When as many names as possible have been written down, the sheet should be clearly marked with the name and address of the competitor.



The contest will be divided as usual into two sections—Home and Overseas. Postal Orders to the value of 21/–, 15/–, 10/6 and 5/– respectively, will be awarded to the four competitors in each section who submit the most complete entries. In addition a number of consolation prizes, consisting of Hornby Train goods (or Meccano products if preferred) will be awarded, and competitors should send in their entries even if they have been unable to decipher the name in every case. In the event of a tie for any prize neatness will be taken into consideration in making a final decision.

Envelopes containing entries should be clearly marked in the top left-hand corner H.R.C. "*Mutilated Names Contest,*" and must be posted to reach Headquarters at Meccano Ltd., Binns Road, Old Swan, Liverpool, on or before 31st October. The closing date for the Overseas section is 30th January, 1932.

It must be remembered that the omission of the H.R.C. number from any entry will cause it to be disqualified. This is an important condition to which members should pay special attention, as its neglect in the past has occasionally caused promising entries to be discarded.

Essay Contest

Each of the four British railway groups runs one or more non-stop trains during the summer months or throughout the year. These trains are very popular, and each differs from the others in character and possesses a distinctive appeal of its own. For our essay contest this month we invite H.R.C. members to tell us which they consider to be "*The most interesting British non-stop Run.*"

Competitors should deal with the subject not only from the point of view of scenery but should take into account the gradients of the route concerned, the types of locomotives and rolling stock used, the sharp timings, and any features of special railway interest along the route.

Members of the H.R.C. at Home and Overseas are eligible to compete and prizes of Hornby railway material, or Meccano products, to the value of 15/–, 10/6, 5/– and 2/6 respectively will be awarded for the four best entries in each section. In addition a number of copies of "*Famous Trains*" by Cecil J. Allen will be given as consolation prizes.

Envelopes containing entries should be marked "H.R.C. Essay Contest," and posted to reach Headquarters at Meccano Ltd., Binns Road, Old Swan, Liverpool, not later than 31st October. The closing date for the Overseas section is 30th January, 1932.

It is essential that the competitor's H.R.C. membership number is stated, as omission of this will result in immediate disqualification.

Drawing Contest

Drawing Contests with objects of railway interest as their subject always produce a good crop of entries. In past contests of this nature we have invited H.R.C. members to test their skill in contests calling for drawings of steam or electric locomotives, or of trains at speed. This month we are taking a new line and we have chosen as the subject of this Drawing Contest "*A Tank Wagon.*"

The competition is not restricted to any particular kind of tank wagon, and competitors may draw either an oil tank wagon of the British or American type, a "United Dairies" milk tank wagon, a petrol tank wagon, a "Colas" bitumen wagon, or a French wine wagon. If desired, the drawing can be coloured according to the type of wagon shown.

The competition will be divided into the usual two Sections—Home and Overseas. To the competitors who submit the four best entries in each of the two sections will be awarded prizes of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively. In addition a number of consolation prizes will be awarded.

Envelopes containing entries should be clearly marked "H.R.C. Drawing Contest" in the top left hand corner and posted to reach Headquarters at Meccano Ltd., Binns Road, Old Swan, Liverpool, on or before 31st October. The closing date for the Overseas Section is 30th January, 1932. Members' H.R.C. numbers must be quoted.

COMPETITION RESULTS

HOME

July "Another Impossible Train" Contest.—First: S. Lucas (2942), London, N.18. Second: L. L. Luck (1685), Fratton, Portsmouth. Third: R. Nicholas (24331), North End, Portsmouth. Fourth: A. Sandison (6558), South Croydon, Surrey. Consolation Prizes: F. M. Clark (2856) Birkby, Huddersfield.; A. R. Holmes (17022), Peterborough; J. M. Johnston (5484), Dunstable, Beds.; R. G. Jennings (17345), King's Norton, Birmingham; J. Corner (23244), Newcastle-on-Tyne; E. D. Bailey (6428), Romford, Essex; R. Wood (179), Gorton, Manchester; T. Wardle (22172), Nottingham; J. T. Trotter (11447), London, S.E.21; J. T. Holmes (9032), Alexandra Park, London, N.22; T. Shuttleworth (11335), Preston, Lancs.; J. Everitt (542), Norbury, London, S.W.16.

July "Questions Contest No. 2."—First: K. Bargh (22150), Dronfield, Nr. Sheffield. Second: R. C. Storrar (8625), Letham Ladybank, Fife. Third: C. W. Lex (14033), Kingston-on-Thames. Fourth: A. Whitesmith (808), Mount Florida, Glasgow. Consolation Prizes: H. E. Jones (14740), Chingford, London, E.4; J. D. Taylor (7757), Carlisle; C. L. Kerr (21147), Langside, Glasgow; A. Baker (11390), Erdington, Birmingham; A. F. Milburn (16322), Chingford, London, E.4; W. K. Tomlinson (10007), Thornton, Blackpool; A. Ainley (17376), Astley Bridge, Bolton; H. A. Osborne (11122), Cardiff; J. Archer (19788), Poulton-le-Fylde, Blackpool; W. Robb (23368), Comber, Belfast; R. Barbary (5580), Mevagissey, Cornwall; W. F. Lever (24206), Penylan, Cardiff.

OVERSEAS

April "Rolling Stock Contest No. 1."—First: G. E. Schulz (15425), Australia. Second: W. Butler (17411), Cape Town, S.A. Third: R. A. Wragg (7913), Bandikui, India. Fourth: P. Heywood (18490), Germiston, S.A. Consolation Prize: B. Chiles (9191), Port Elizabeth, S.A.

April "Station Layout" Contest.—First: J. A. Rodriguez (3647), Montreal, P.Q., Canada. Second: B. Willis, Toronto, Canada. Third: J. A. Coates (23863), Verdun, Quebec, Canada. Fourth: A. Douglas, Palmerston North, New Zealand. Consolation Prizes: D. Matthews (16420), Cape Town, S.A.; R. Kelly (24120), Auckland, New Zealand; F. Van Bulck (1875), Forest-Brussels, Belgium.

BOYS! HERE'S A PAGE TO LINGER OVER

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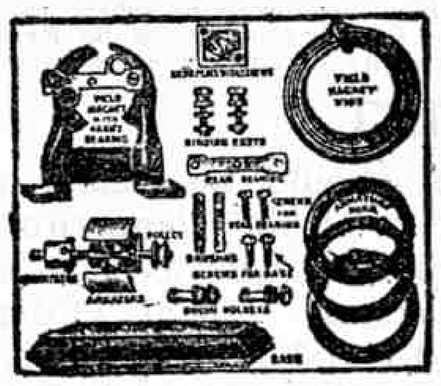

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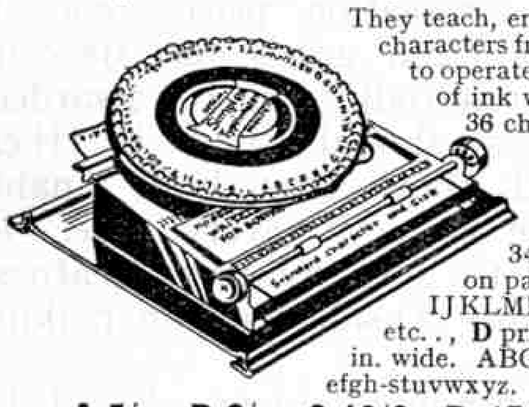

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A 5/-. B 8/-. C 12/6. D 15/-. Post extra on each.

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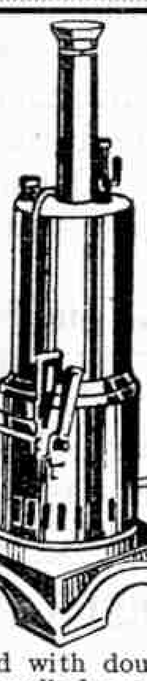
A TRIUMPH OF PRODUCTION

Beautifully constructed, and strongly built, an excellent flyer. Can be launched in the air or will rise up from the ground. Wing span 23 in. Length 27 in. Compare the value.

Gamages Price only **4/6** Post 6d.



VERTICAL STEAM ENGINE

With brass boiler, satin finish oscillating cylinder, steam whistle and safety valve. Hours of fun can be obtained with this, particularly if a few working models are added. Very good value. Height overall 11½ in. Price **6/6** Post 9d.

DONKEY ENGINE

Fitted with double-acting slide valve cylinder and slip eccentric reversing gear. Boiler of polished copper, 2¾ in. diam. Height to top of chimney 10¾ in. Cylinder is fitted with lubricator and boiler has safety valve, starting tap outlet cock and whistle. The engine is fitted with reduction gear which gives exceptional power at low speed. Cast iron enamelled base 4½ × 5½ in. Price **30/-**
No. 2, same specification as above but smaller and without reduction gear. Height overall 8 in. Diam. of boiler 2½ in. Price **21/-**

BOXES OF CONJURING TRICKS

Full instructions in every Box. The most complete sets of conjuring tricks that have ever been offered to the public at the prices quoted. Every boy interested in the fascinating art of conjuring should send for one of these cabinets at once.

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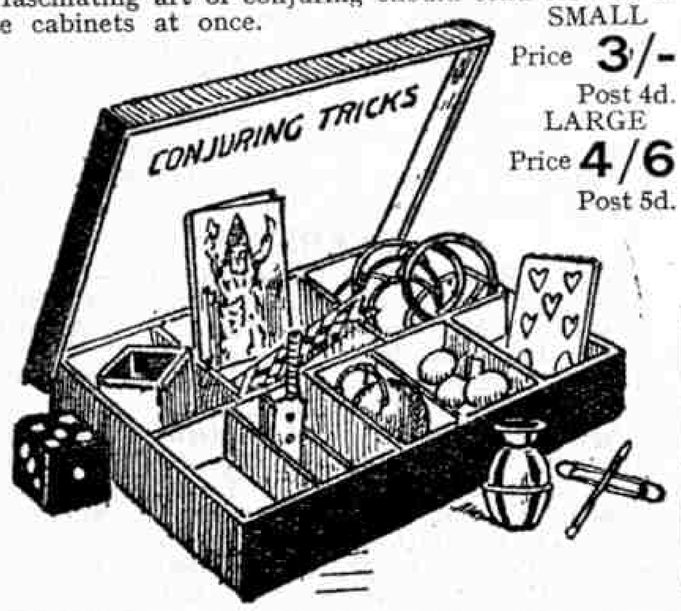

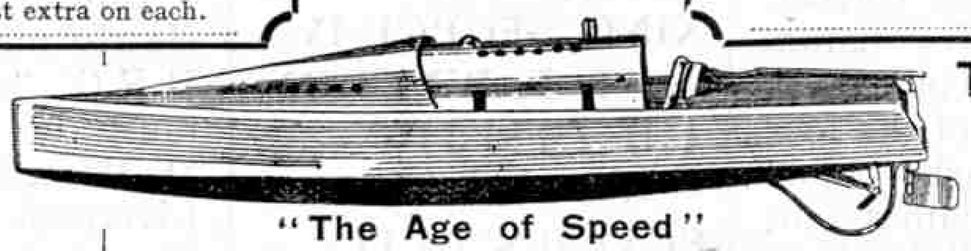

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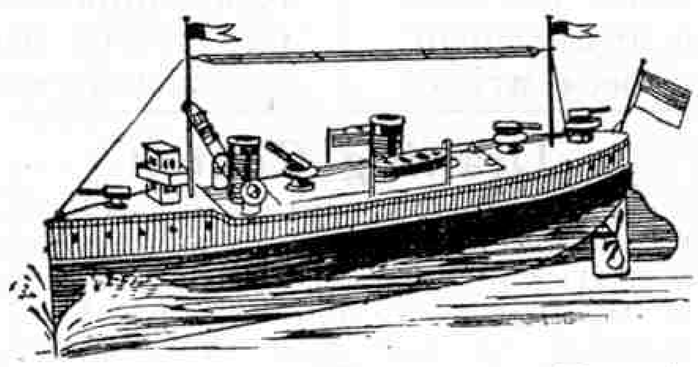
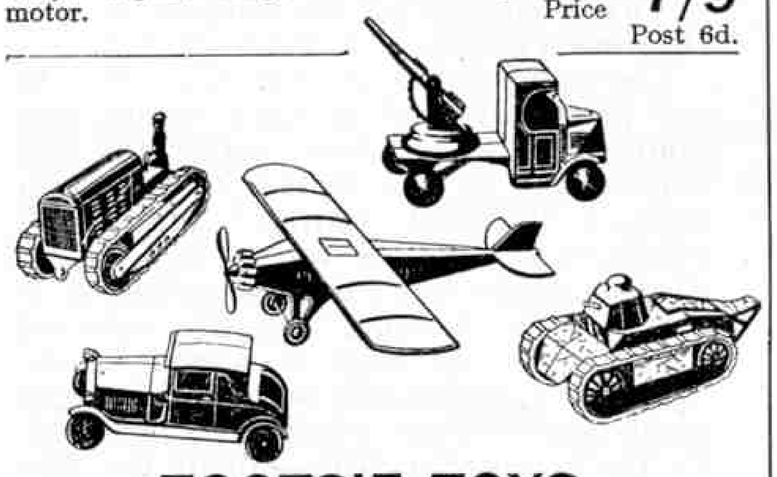
Will easily outship your rivals. Fitted with Twin Steam Engine, and embodies all the latest principles of construction. Length 20 in. Price **17/6**
Smaller models with single steam engine, 23 in. **22/6**, 28 in. **32/-**. Length 28 in. Price **42/-** Post 9d. extra.



Clockwork Torpedo Boat

As illustration, beautifully enamelled in Elephant Grey. 10½ in. long, fitted with powerful motor. Price **7/9** Post 6d.



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This series of attractive coloured models includes Model Aeroplane, Tank, Tractor, Anti-aircraft gun, and Ford Car. The set of 5, Price **2/6** Post 6d.

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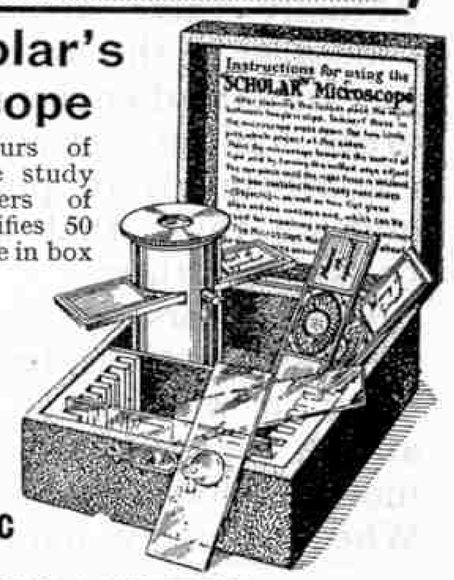
Will give hours of interest in the study of the wonders of nature. Magnifies 50 times. Complete in box with 2 prepared slides, 4 spare slides for mounting various objects, and instructions. Post 3d. **3/6**



Convert Your ELECTRIC TORCH into a MAGIC LANTERN

This lantern attachment is adaptable to any Electric Torch or Hand Lamp. Complete with 3 slides. Post 3d. **1/9**
Extra slides 1/- per dozen. Post 3d.

Statham's Chemical Outfits

A fascinating and instructive hobby.

No. 1 BOYS' CABINET

Contains 17 Chemicals, apparatus and leaflets of instructions. Price **3/3** Post 6d.

YOUTHS' CABINETS

No. 1. Contains Statham's "Practical Chemistry Experiments," Part I, setting out fifty interesting and instructive experiments. Price **8/6** Post 9d.

No. 2. A more elaborate set than the Youth's No. 1. Contains complete apparatus and Chemicals (except acids) necessary with Statham's Part I booklet. Price **12/6** Post 9d.

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Competition Page

MY FAVOURITE BOOK—VOTING CONTEST

When evenings are long and school work done, few boys can resist the lure of a good book and a comfortable fireside seat. But how tastes in books vary! One boy of our acquaintance reads little else but school yarns; another will not look at school stories but literally devours detective "thrillers"; yet another is an engineering enthusiast. Other boys have varying tastes ranging over many types of literature, but deep down in his heart every boy has his favourite style and the purpose of this competition is to give readers an opportunity of expressing their individual views and forecasting the taste of the average boy.

We list here ten of the most popular classes of literature and in each have indicated a typical book of that particular class as a guide to those readers who have never attempted to classify their tastes:—

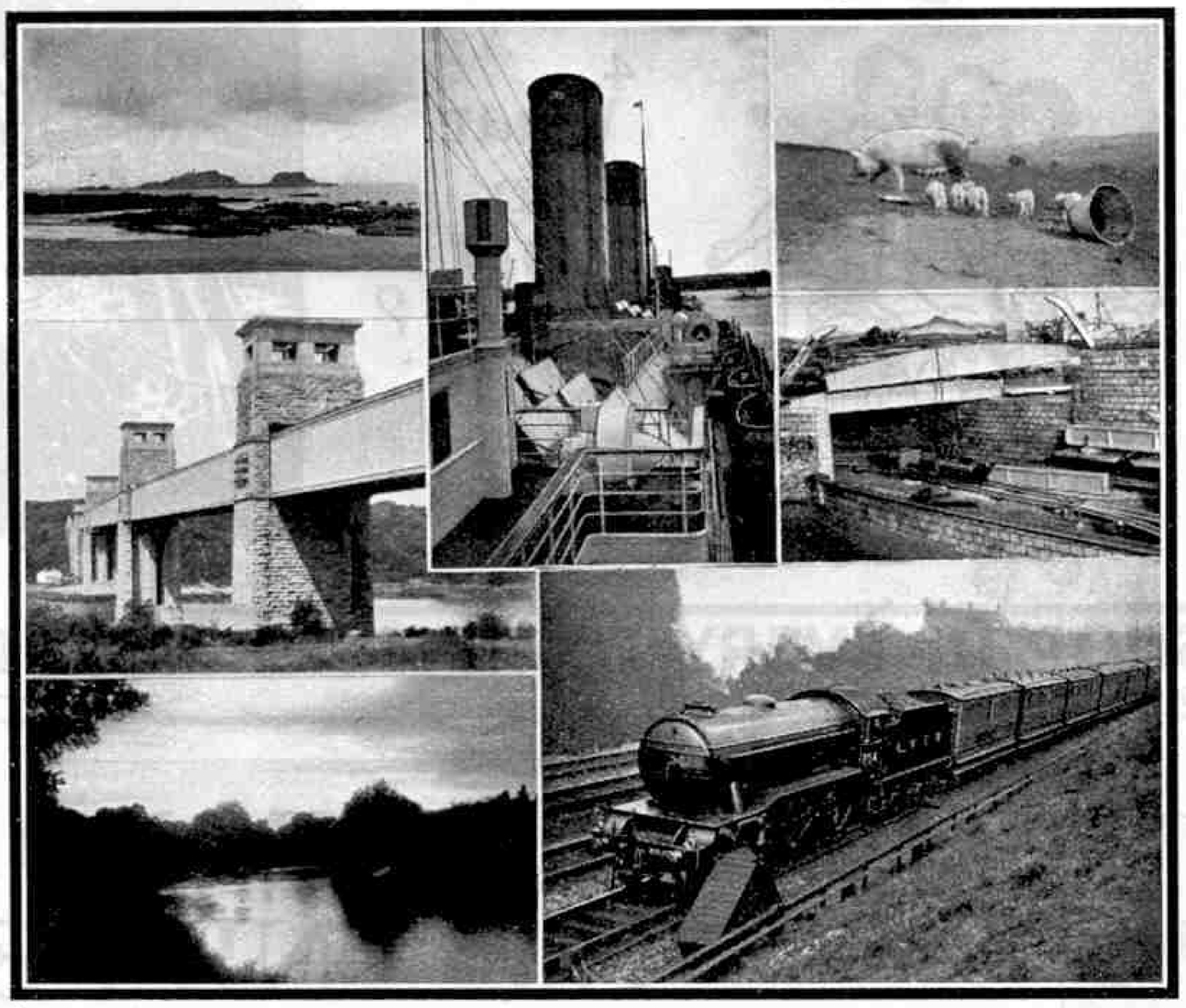
Adventure, *"Strange Tales of the Seven Seas"*; **Biography,** *"Smith of Birkenhead"*; **Detective,** *"The Adventures of Sherlock Holmes"*; **Engineering,** *"The Book of Mechanical Wonders"*; **History,** *"The Pageant of Civilisation"*; **Natural History,** *"Bird Life in England"*; **School Stories,** *"Tom Brown's Schooldays"*; **Scientific,** *"Pioneers of Wireless"*; **Sport,** *"The Boy's Book of Cricket"*; **Travel and Exploration,** *"The Land of the Sun God."*

Readers are invited to write on a post card, first their own particular favourite class from this list, and then a list of these classes in the order of popularity that they think the massed votes of all the competitors will show. The names of the typical books must not be given, the classes only being required.

Prizes of Meccano products, or, if the winners prefer, books of their own choice, to the value of 21/–, 15/–, 10/6 and 5/– respectively, will be awarded to the four competitors whose lists most accurately forecast the final results of the voting. In addition there will be a number of consolation prizes. In the event of a tie for any or all of the prizes, preference will be given to the entry showing the neatest or most novel presentation.

Entries should be addressed to "Book Votes, Meccano Magazine, Binns Road, Old Swan, Liverpool," and must be sent to reach this office not later than 31st October. Overseas closing date, 31st January, 1932.

Competitors are reminded to write their names and addresses on all competition entries. In almost every contest we hold, one or more promising entries have to be passed over, due to the omission of this information.



A group of prize-winning photographs from the July Competition. Reading from top to bottom the titles and entrants' names are as follows:—Left Hand: "Fidra," M. Whittet (Glasgow); "Mena Tubular Bridge," S. Garbutt (Altrincham); "Evening on the Thames," J. B. Gibson (Egham). Centre: "The Majestic, looking up from the Bridge," E. H. Morris (Ashtead). Right Hand: "Now we'll look for more," W. Cawthra (Bradford); "Bridge Construction," H. L. Combe (Harrogate); "L.N.E.R. 2-6-0 Mogul No. 204," T. Renshaw (Manchester).

"Pets" Drawing Contest

We have never held an animal drawing contest in the *"M.M.,"* but many of our readers would revel in an opportunity to gain a prize with a drawing of his pet. This month, therefore, we offer prizes for the best drawings of readers' pets—drawings of animals, birds, reptiles or fish are equally eligible, of course.

Entries will be divided into two sections, A for those from readers aged 16 and over, B for those from readers under 16. Prizes of Meccano Products or Artists' Materials, as selected by the winners, to the value of 21/– and 10/6 respectively will be awarded to the best and second best entries in each section.

Every competitor must write his name, age and address on the back of his entry, which should be addressed to "Pet Drawings, Meccano Magazine, Old Swan, Liverpool." Closing date; 31st October; Overseas, 31st January, 1932.

COMPETITION RESULTS

HOME

Test Match XI.—Our Overseas competitors always take a considerable degree of interest in cricket competitions and for that reason we cannot comment on the voting in the Home section of the Test XI Contest at this stage. For the moment, let us say that the Eleven chosen by the massed vote was a remarkably good one, well equipped at all points.

Only one competitor succeeded in choosing the exact XI of the popular vote, but several readers differed in one player only and—with the simple exception of two entrants who omitted to give their names and addresses—every one of these competitors has been included in the prize list, which follows:—

1. A. P. Yorke (Kendal); 2. J. C. Rutter (Cardiff); 3. W. R. Berwick (Birmingham); 4. E. Mosedale (West Kirby). Consolation Prizes: E. Baker (Guildford); E. G. Doudney (Ilford); C. J. Finch (Redbourn); A. R. Nuben (East Sheen, S.W.14); G. S. Marsh (Blackpool); "M.M." Reader (Burton-on-Trent); J. Speed (Wormit, Fife); C. E. Thompson (St. Leonards-on-Sea); K. D. Wadsworth (Crosby).

June Crossword Puzzle.—1. J. W. S. Fortune (Plumstead, S.E.18); 2. P. T. Atkinson (Norton-on-Tees); 3. F. S. Hales (Andover); 4. N. J. Ranson (Cliftonville). Consolation Prizes: J. F. Armstrong (Maidenhead); S. M. Beaumont (Dublin); K. Costain (Bolton); J. R. Farebrother (London, S.W.16); R. Figgins (Angle); R. Linley (Wallington).

July Photo Contest.—First Prizes: Section A, E. H. Morris (Ashtead); Section B, W. Cawthra (Bradford). Second Prizes: Section A, A. B. Bishop (Bristol); Section B, R. M. Smith (Stanmore). Consolation Prizes: W. E. Cavanagh (Offaly); H. L. Comber (Harrogate); S. Garbutt (Altrincham); J. B. Gibson (Egham); W. Putney (Malton); T. Renshaw (Manchester); J. Sanderson (Glasgow).

August Photo Contest.—First Prizes: Section A, J. W. Hollyoak (Coventry); Section B, Miss P. Challis (Bexhill-on-Sea). Second Prizes: Section A, Wm. Robb (Belfast); Section B, J. L. Rice (Rugeley). Consolation Prizes: J. E. Martin (Fishguard); F. J. A. Nash (Wallington); C. Wrigley (Wallasey); N. M. V. Young (Bedford).

OVERSEAS

Cover Voting.—A comparison of the results of the voting in the Home and Overseas sections of this contest is particularly interesting, and so that readers may inspect them for themselves, we append the result from both sections.

Home: August, November, September, January, May, December, June, July, April, March, February, October. **Overseas:** August, November, September, June, December, January, April, May, February, October, July, March.

The prizes were awarded as follows:—1. E. Brickhill (Transvaal, S.A.); 2. A. J. Cramp (Sydney, N.S.W.); 3. R. Mayes (Kyogle, N.S.W.); 4. C. Wagener (Adelaide). *(Cont. on page 854)*

CUPBOARD LOVE

A NOVEMBER IDYLL

1.
When its early in November
And the kiddies lie in wait
For you coming home from business
Growing anxious if you're late

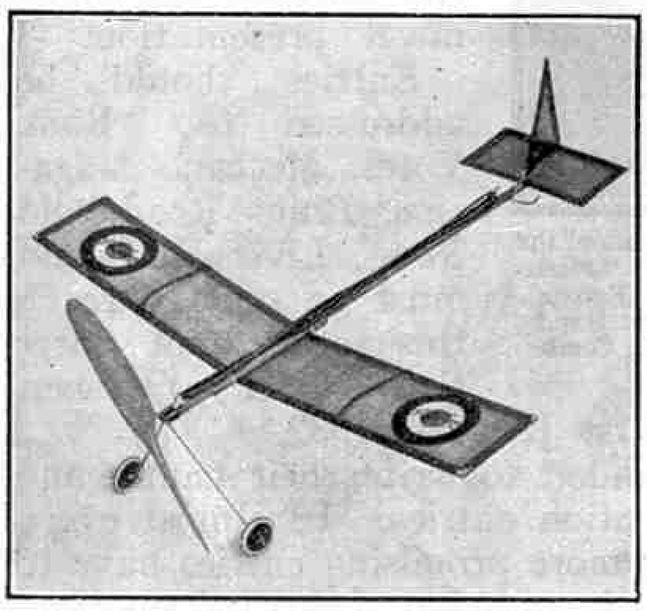
2.
When your chair is by the fire
And your slippers warm as toast
And there seems a competition
As to who can serve you most

3.
When you wonder where the catch is
As to every whim they've pandered
They murmer "its November fifth
And the fireworks must be.....

4. What do **you** think?

THERE'S A SHOP IN EVERY TOWN SELLING "Standard"

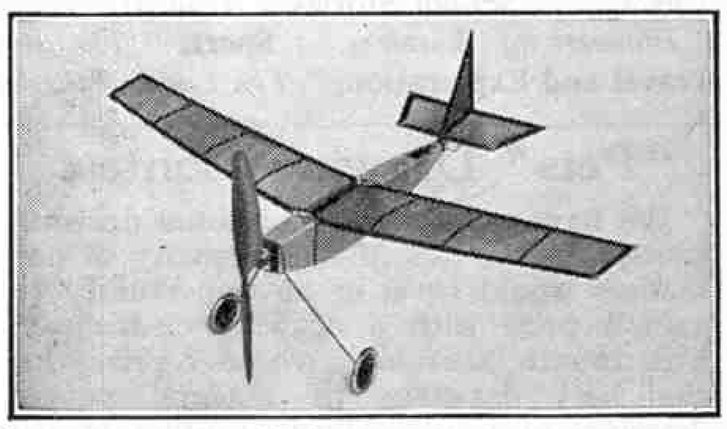
STANDARD FIREWORKS LIMITED, HUDDERSFIELD



HERE'S A WONDER LINE
The "NIPPER"
WARNEFORD of course!

Performance Counts—Not Size!

FREE! All Warneford Models are capable of a duration of 30 secs. Any pilot who obtains this performance with a duly witnessed flight is entitled to the certificate and Blue and Gold Wings of the WARNEFORD JUNIOR AIR LEAGUE. An entry form and full particulars are enclosed with every Machine retailing from 4/6 upwards. New descriptive booklet post free on application.



The "NIPPER" Price 2/6

Special Features:

A long bearing allowing no movement or wobble on the propeller—therefore a steady flyer. High tension steel wire tail and rudder—therefore model can be adjusted for stunting. All aluminium wheels, fitted brass bearings, and the model has an amazing performance as the whole Aeroplane weighs less than one ounce. The finest machine ever produced at such a price.

The "WHIPPET" Fuselage Model Price 17/6

Fitted 11-in. hand-carved and balanced propeller, and covered orange proofed silk. This beautiful Fuselage Model Aeroplane has an excellent performance, is very strong, and has full adjustment of main-plane, tail and fin. It dismantles and folds so that it fits into a very small box for storage and transport, the finish is in keeping with the usual Warneford high standard, and at its price it is undoubtedly the finest value ever offered. Weight, 4⅜ ounces. Distance, 550 feet. Speed, 17 m.p.h. Ceiling, 50 feet. Rises from the ground.

OTHER WARNEFORD MODELS FROM 1'6 TO 35'-

Warneford Aeroplanes are obtainable from all good Stores, Toy Shops and Sports Dealers throughout the country.

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Fireside Fun

OUT FOR NEW BUSINESS

A doctor one evening received a visit at his surgery from a small boy.

"Say, Doctor," said the boy. "I've got the measles, but I can keep the news to myself."

The doctor was puzzled, and finally asked the boy what his idea was.

"Just this," replied the small patient. "If you will make it worth my while, I will go to school and scatter it among the rest of the pupils."

* * * *

They were touring in the Lake District.

"I think this scenery is just beautiful," said the cheery one.

"Do you?" replied the other. "If you took away the mountains and lakes, you'd find it just like anywhere else."

* * * *

The unsuccessful novelist was enquiring about his latest manuscript.

"This is quite well written," said the publisher, tactfully, "but owing to bad conditions generally, my firm are only publishing work by writers with well-known names."

"Splendid!" said the caller. "That means you accept it, doesn't it? My name's Jones, you know."

* * * *

The "country cousin" was being shown his room by the Irish "man of all work."

"Well, sorr," said Pat before retiring, "when you want to get up in the morning, just press that button over there by the door and then we'll come and call ye."

* * * *

Jim: "Many happy returns, Jack! Did you get any surprise presents for your birthday?"

Jack: "Rather! Bill gave me a book that I lent you last year."

* * * *

The barber had finished the customary preliminary talk about the weather.

"Your hair is getting very thin, sir," he continued. "Ever use our patent hair-restorer?"

"No, don't worry," said the customer, "it wasn't caused by that!"

* * * *

A famous novel had been filmed and was being shown at the local cinema.

"I must read the novel before I see the film," said Father.

"But why?" queried Mother.

"Because if I read the novel first I find it so much harder to guess the plot of the picture."

* * * *

DEEP UNDERTAKING!

The motorist had run into a very muddy patch and was struggling with a shovel in an endeavour to dig out his car.

"Stuck in the mud?" queried a passing yokel.

"No," replied the motorist with feeling; "my engine's just died and I'm digging its grave."

DEAD CERTAINTIES

Mrs. Wilson: "I think our doctor is so persevering, whatever the difficulties that confront him. He always makes me think of patience sitting on a monument."

Mr. Wilson: "Yes, but what worries me is the number of monuments sitting on his patients!"

* * * *

As Brown got into the train he saw that Smith and Jones were deep in conversation.

"Yes," he heard Smith say, as he approached, "I'm afraid it means a dozen sittings at least."

"Going to have your portrait painted, Smith?" demanded Brown.

"No," came the reply. "I am learning to skate."

* * * *

Mother: "What are you making baby cry for?"

John: "It's not my fault. You said I was to teach her all I could, didn't you? She's crying because I took her biscuit to show her how to eat it."

* * * *

NO EFFORT REQUIRED

Awestruck Listener: "How did you manage to keep cool when confronted by the bear!"

Traveller: "Oh, I kept cool without any effort. In fact, I was so cool that my teeth chattered."

* * * *

"Hullo, Brown! Haven't you gone away yet? You said a few days ago that you were going to take a holiday this week."

"Yes, I know, but I was let off with a fine."

* * * *

Doctor: "Has he been taking the medicine regularly, nurse?"

Patient: "No, I haven't. I tasted it and decided that I'd rather have the cough."

* * * *

Teacher: "Why did you say in your essay that Atlas was a bad man?"

Pupil: "Well, sir, it says in my book that he held up the whole world."

* * * *

Lawyer (endeavouring to trip up important witness): "Don't you think you are straining a point in your explanation."

Witness: "Well, perhaps I am. You will agree, however, that it is often necessary to strain things to make them clear."

* * * *

Tramp: "Could you please spare something for a cup of tea, sir?"

Mr. Meanman: "Away with you! Do I look the sort of person who would carry milk and sugar around with him?"

* * * *

The inquisitive "foreigner" was visiting a friend in the Highlands.

"Did you have much snow last winter?" he asked.

"Not verra much," replied the Scot. "My neebor-r had much more than I did."

"How could he?" queried the other, "he doesn't live more than a mile away."

"Weel, he's got more land than I have."

* * * *

Editor (kindly): "I'm sorry but I can't accept these poems. You should type your manuscripts."

Poet: "If I were clever enough to type do you think I should waste my time writing poetry."

* * * *

Judge: "How is this? You were charged with robbery from an office only a week ago, and were let off. Now you're here again for bank robbery."

Prisoner: "Sorry, your Worship, but I had to do something to get money to pay off my lawyer."

MONEY TO BURN

Smith: "I see Binks has got a motor car."

Brown: "Yes, his uncle left it to him in his will."

Smith: "But he told me he put all his money into it."

Brown: "Quite right. He bought two gallons of petrol for it."

* * * *

A dear old lady had been to France for the first time and was relating her experiences.

"What made the deepest impression on you?" she was asked.

"Well," she replied, after a moment's thought, "I think it was hearing the French pheasants singing the mayonnaise."

* * * *

"Big wars often start from very little causes," remarked Mr. Jones thoughtfully. "I've proved it."

"What do you mean?" asked his friend.

"The other night my wife was trying to work out a crossword puzzle," replied Mr. Jones. "She asked me what a female sheep was and without thinking I said 'Ewe.' And then trouble began!"

* * * *

Teacher: "How many wars did Spain wage during the seventeenth century?"

Tommy: "Seven, sir."

Teacher: "Seven? Enumerate them!"

Tommy: "One, two, three, four, five, six, seven."

* * * *

"George," said his doting mother, "that isn't the watch I gave you last Christmas, is it, dear? I feel sure that the one I bought had a gold case and this one is silver."

"Yes, mother," stammered George, "you see-er-I was very hard up last term, and -er -er—you know, mother, circumstances alter cases."

* * * *

The Royal Academician noticed a drawing of a fish by a pavement artist, and asked what sort of a fish it was supposed to be.

"A shark, sir!" replied the artist.

"It is quite clear that you have never seen a shark," said the R.A. with a contemptuous laugh.

"That's right, sir," said the artist. "But after all, some of those Academy chaps have painted angels, you know?"

* * * *

"We don't want to know what you think; we want to find out what you know," thundered the lawyer.

"It is no use my stopping here, then," replied the witness. "I am not a lawyer and can't talk without thinking."

* * * *

Office Manager: "This won't do, Jones. We provide you with these efficiency appliances, and you take no notice of our system."

Jones: "Perhaps not, sir. You see somebody has to get the work done."

* * * *

Ill-mannered Diner: "Hey! Waiter."

Waiter: "We don't serve it here, sir!"

* * * *

HARPOONING PRACTICE

It was the novice's first catch, a very small trout, and in his excitement he wound it in until it was rammed against the end of the rod.

"What do I do now?" he asked his companion, excitedly.

"Why," said the other, who was tired of silly questions, "climb up the rod and stab it, of course."

LOOK AT THESE SETS!

NYASSA. (S3547), 1921 Pictorials: Giraffe, da Gama, Zebra, Ship and Dhow, 18 un., 3/6. (S572), a shorter set of above, 16 un., 1/3. **NYASSA.** (S1576), Triangulars (Giraffe, Zebra, etc.), 9 un., 1/3. **LABUAN.** (S3841), 1894, Stag, Dyak, Palm, Pheasant, etc., 11 un., 5/–. **BORNEO.** (S3843), 1894, Similar Zoo Set, 11 un., 4/6, or (S3842), a shorter set, 9 un., 2/6. When ordering, add 1½d. to above prices, for postage, and ask for approvals of the countries you collect.

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This historic set was put on sale for use in the territory of **Belgium,** that was occupied by **Germany** during the Great War, in 1916-18. No collection is complete without these stamps. To all Stamp Collectors sending 1½d. postage (abroad 2½d.), I will send this set **absolutely free.**

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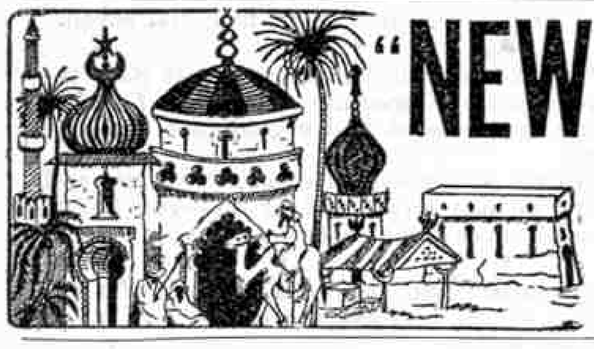

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Owing to the enormous success of the "Oriental" Packet, I am now offering a slightly different Packet of Orientals of even better value. **30** Stamps in all: **EGYPT** (large pictorial, etc.), fine Set of **6 TURKEY** (pictorials, etc.), Set of **PALESTINE, SYRIA** unused, Set of **ALGERIA,** including high values, **MESOPOTAMIA,** Set of **TUNIS** new issues, etc., **ALAOUITES** (Minaret), **GREEK** surcharged, a beautiful Set of **MOROCCO, AIRPOST,** etc. Price **4½d.,** postage **2d.** (abroad **3d.** extra). **PURCHASERS OF THE ABOVE PACKET** asking for Approval Sheets will be presented with a unique Set of **10 PERSIA** (usually sold at **1/6**). Satisfaction guaranteed or money returned. Senders of Addresses of Stamp Collecting Friends will receive in addition another Set **FREE.**

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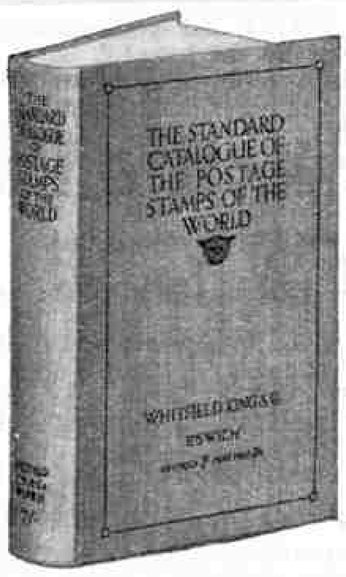

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Everything for Stamp Collectors in Pictorial Metal Case.

WITH SCARCE PERSIA HORSE-POST (Cat. 1/6).

Contained in the **Free Casket** are Matlock Tweezers (with spade ends), Crystal Clear Envelopes, Marvellous Matlock Mounts and a **Rare Persia Resht-Teheran Horse-Post Issue** (Cat. 1/6). The Handsome Metal Gift Casket has hinged Lid, showing in colour **The Highest English Precipice** at Matlock. It also combines in a unique way a **Watermark Detector** and an **Accurate All-Metal Perforation Gauge.** Send only 3d. postage, or if you would like a **Powerful Magnifying Glass** as well, 4d. in all must be sent.

Ask for Approvals.

VICTOR BANCROFT, MATLOCK, ENGLAND.

A STAMP HISTORY OF AVIATION

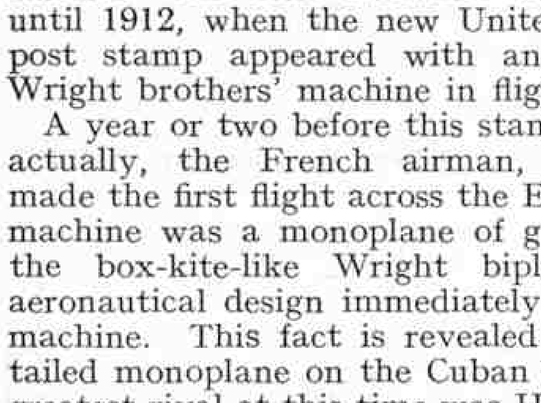
FEW branches of stamp collecting hold out greater promise of personal pleasure and financial reward than aero-philately, and in counselling the new collector who seeks an outlet for his enthusiasm to devote himself to aero-philately, it is possible to say with absolute confidence that he will find a hobby worthy of his best endeavours if he will devote himself to building up a collection of official Government issues illustrating the development of aviation and air mail transport.

It was in December, 1903, that Wilbur Wright made his first successful flight, but many years before that flight a stamp issue had foretold the coming of an era when mails would be carried by air. The corners of the Japanese 12 sen stamp of 1876 showed illustrations of four little balloons. Strictly this stamp is not an air mail issue, but it would be a happy first inclusion in any air stamp collection, for it is definitely the first stamp allusion to aeronautics. The next reference was delayed 36 years until 1912, when the new United States 20c. parcel post stamp appeared with an illustration of the Wright brothers' machine in flight.

A year or two before this stamp appeared, in 1909 actually, the French airman, Louis Bleriot, had made the first flight across the English channel. His machine was a monoplane of greater stability than the box-kite-like Wright biplane, and naturally aeronautical design immediately came under the influence of his machine. This fact is revealed by the appearance of a lattice-tailed monoplane on the Cuban express stamp of 1914. Bleriot's greatest rival at this time was Henri Latham, who had also built a monoplane, to which he gave the name *Antoinette*, in virtue of its beauty. This machine was greatly favoured in Central European military circles, and the early War *Albatrosses* of the Austrian flying services were modelled on very similar lines. An excellent illustration of the *Albatross* machine is given on the 35h. Austrian 1915 Charity issue, illustrated here.

The tale of pre-War aeroplane design is completed by the inclusion of the Bolivian special issue of 1924 celebrating the establishment of a National Flying School. This issue illustrated the Morane-Gnome parasol monoplane, another French type.

The effect of the Great War upon aeronautical design is excellently recorded in the stamps that appeared in the years immediately following its conclusion. The biplane had almost completely ousted the monoplane in France and its dependencies, and the Moroccan air stamp of 1922, illustrated, show excellently the great improvement in this type of machine. Note the streamlining and the roomier fuselage, the absence of landing skids, and the general cleaning up of air-resisting features. The monoplane retained its popularity in Germany, however, although the first German air stamps of 1919 showed a typical slim-tailed German biplane. It is left to the Danzig Free State issue of 1921 to show a commonly used type of German high wing monoplane.



The introduction of multi-engined machines is recorded by the appearance of a two-engined Vickers-Vimy biplane on an unofficial stamp of Australian origin used for mails carried on the Ross-Smith flight from England to Australia in 1920. The same type of machine was used by Alcock and Whitten Brown for their flight from Newfoundland to England in 1919, and an excellent illustration is shown on the 15c. Newfoundland stamp of 1928.

In 1924 a Russian air post series gave the first indication of passenger-carrying, but for our illustration we turn to the Egyptian issue of 1926. The de Havilland biplane shown here is considered by many to be the finest aeroplane illustration available on stamps. The de Havilland 9 machine, a famous war time type, is shown on South Africa's 1925 issue.

In more recent years the influence of post-war design has been revealed particularly in the illustration of low wing monoplanes of the Junkers and similar types. Among the earliest stamps showing these machines were Lithuania's 1921 issue. Other good examples are to be found on Leichtenstein's issue of August, 1930.

The seaplane makes its first appearance on the Portuguese 1923 issue commemorating a flight from Portugal to Brazil in which Fairey machines were employed. An interesting seaplane design for an overprint was introduced in the Philippine Islands in 1923 to celebrate the arrival in Manila of a British Air Squadron. The overprinted stamps were issued to frank mail carried from Manila to Hong Kong on the continuation of the flight. Flying boats appear for the first time on Cuba's 1927 issue, but the attractive Spanish "Plus Ultra" stamps issued in 1926 as a Red Cross Charity series, provide a better illustration.

The issues of 1929 and 1930 are chiefly notable for the indication they give of the spread of the use of air mail transport, the issue of special stamps in various countries revealing the opening up of new air routes. Interesting British features are the Australian, South African and, most important, the Indian issues, the last named featuring one of the D.H. *Hercules* machines.

The development of lighter-than-air craft is the final phase of our story, and the Brazilian issue of 1929,

(*Continued on page 843*)

STAMPZ IN SAX GENUINE MISSION SOLD IN SEALED SAX AS IMPORTED

Two Scarce Stamps catalogued at 12/- Given Free to purchasers of a No. 9 Mission Sack of Stamps (sold exactly as imported from Convents abroad).
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No unwanted Approval Sheets are sent.
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from which you may select any 100 for 3/-. This selection is **not** made up of the thousand commonest stamps, but contains specimens priced by Stanley Gibbons up to 1/- each. For 3/- you have the opportunity of choosing 100 stamps of the catalogue value of 20/- or more.
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*9	**Nyassa Triangular,** 1924. Complete set ...		7d.
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4	**Belgian Congo,** 1920. Large Air Mails ...		1/3
19	**Persia,** 1922. "Controle" set (Cat. 21/8) ...		2/9
*9	**Fiume,** 1922. Rare pictorials (Cat. 4/9) ...		1/-
*9	**Salvador,** 1898. Pictorial set		4d.
*3	**Abyssinia,** 1894. Emperor Menelik (Cat. 3/-)		6d.
*5	**Abyssinia,** 1919. Large animal set (Cat. 5/-)		11d.
25	**Air Mails**	5d.	
25	**Greece** ...	4d.	
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*20	**Nicaragua**	6d.	
*20	**Salvador**	7d.	
100	**British Colonials** ...		9d.
100	**French Colonials** ...		9d.
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500	**Different Stamps** ...		1/5

* **Unused.** Postage 1½d. extra. All different.
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24 AIR MAIL STAMPS—FREE!
(ALL DIFFERENT).
THIS SPLENDID PACKET WILL BE GIVEN FREE TO EVERY APPLICANT FOR MY APPROVALS. Send 1½d. stamp for postage.
AIR MAIL AND PICTORIAL STAMPS AT BARGAIN PRICES.
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Containing 25 diff. fine stamps from **BECHUANALAND PROT.** (Overprinted on G.B.), Cyprus, **ANGOLA,** Azores, **ST. LUCIA, BHOPAL** (Service), Cape Verd Is., Guinea, **RUSSIA** (Old large 1 Rbl.), Mozambique, St. Thomas and Prince Is., etc., etc. Send 1½d. for postage, and ask to see my approval sheets of fine selected stamps.
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2/6 BOXES POST FREE. Abroad Extra. **1/1,500 Well Assorted Unpicked Stamps.** These Stamps are obtained from **Foreign Missions** abroad and are sold just as imported. Countries represented:—West and South Africa, Bahamas and Fiji Islands, Jamaica, Kenya, New Zealand, Morocco, Falkland Isles, Australia, Straits Settlements and surrounding States (Kedah, etc.), Danzig, Russia, Finland, and many other countries too numerous to mention. Many good Stamps have been found in these mixtures. "My boys are delighted with their boxes," writes one client.
JOS. H. GAZE, DIDSBURY, MANCHESTER.

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To introduce my approval service to serious collectors, I am offering 125 different stamps free to all genuine applicants who request to see my approval books of British Colonials and Pictorials, priced from ½d. each less 25% discount. This excellent packet includes British and French Colonials, Pictorials, etc. Send in your application as soon as possible.
ERIC J. WATTS
48, London Road, NORTHAMPTON

FREE To all genuine applicants for my "BETTA" APPROVALS (Large discounts) sending 3d. only, postage and packing, I will present free my famous
MEDITERRANEAN PACKET
containing Stamps from this sea's shores such as **Crete, Cyprus, Epirus, Greece, Egypt, Lemnos, Malta, Montenegro, Sardinia, Thrace,** etc., etc.
Send at once to:—
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NYASSA, 1911 Republic issue, 10 cat. 2/10 for **10½d.**
MONTENEGRO, 1910, complete set of 12, Price **9d.**
PORTUGAL, 1927 or 1928, Independence, each set of 10 ... ... **6d.**
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ECUADOR, 20 used, including air stamp, only **6d.**

40	Liechtenstein	1/-	25 Air Mail ... 7d.
50	Luxemburg ...	1/6	50 Greece 1/5
100	Portugal ...	2/-	50 Jugo Slavia ... 8d.
25	Saar	9d.	25 Latvia ... ... 9d.

HAROLD STROUD, 57, New Bank Rd., Blackburn, Lancs.

NORTH LONDON EXHIBITION
STAND 156
ALEXANDRA PALACE, 14th to 24th Oct., 2 p.m. to 10 p.m. We are exhibiting again in the Organ Hall in the same position as in previous years, and shall be pleased to show old and new friends a large selection of stamps and accessories. Local customers should apply to us for Free Complimentary Tickets giving admittance to the Exhibition.
O. NERUSH, 68, TURNPIKE LANE, HORNSEY, N.8.

1,000 PACKET A WONDERFUL OFFER
The "**1,000** Packet" contains **500** excellently assorted Stamps, a COMPLETE SHEET of **100** UNUSED (very useful for exchange purposes); a neat **12-page** booklet for holding duplicates; **25** British Colonials, usually sold at ½d. to 1d. each, including new and obsolete issues: **375** Magic "Strip" Mounts, and my price list of stamp bargains. Price **4½d.**, postage **2½d.** extra, abroad **6d.** extra. In addition, free sets will be sent to those who send names of stamp collecting friends. *Ask for my famous approvals.* Special bargain, **20 Air Post** for **6d.** **H. C. WATKINS, M. Dept., Granville Road, BARNET.**

CANADA:
7 Canada 1922-25 sent free to applicants for approvals from
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ROYDON HAMLET, WARE.
Postage extra.

KEEP THAT SCHOOLBOY COLLECTION
and add to it weekly from my
BARGAIN APPROVAL SHEETS
including Mint and Rare Colonials.
Choose any 2/6 worth for **1/-**
" " 7/6 " " **2/6**
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Particulars of Free Gifts to Applicants.
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The following Sets are a few of the many hundreds contained in my latest List, post free, on request.

9	**CYPRUS,** Queen & K. Ed. Issues		1/-
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7	**NATAL,** Queen ½d., 1d., 2d., 2½d., 4d., 6d., 1/-		1/3
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4	**ST. HELENA,** K. Ed.		1/4
7	**SEYCHELLES,** K. Geo.		1/-

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FREE 20 DIFF. PERSIA
Send at once for this wonderful packet of Pictorial Stamps, including many scarce issues, showing the Lion of Persia. Large two colour Stamps, various Overprints, Shahs, Ahmed Felege, Pahlavi, etc., FREE TO APPROVAL APPLICANTS ENCLOSING 2d. FOR POSTAGE.
J. BURTON, 31, ONSLOW RD., LIVERPOOL

5 LIBERIA FREE 5
To applicants for my famous books of ½d. Stamps, and sets of Stamps. Without approvals, price 6d. Postage 1½d.
S. H. Fleming, St. Winifreds, Christleton Rd., Chester.

Belgian Congo AIR MAIL
Superb used set 50c., 1 fr., 2 fr. and 5 fr. 1/7½ P.F. Have you got particulars of
GEORGE LAZENBY,
16, Redburn Drive, Shipley, Yorks.

THE M.S.N. CIRCLE ?

100 DIFFERENT, including 5 Montenegro, free to all applicants for our Approvals. Bargain Sets. 11 Italy, Historical, 8d.; 8 Spain, Catacombs, 4d.; 10 ditto, 6d.; 9 Boy King Michael (now scarce), 5d.; 11 Montenegro, 7d.; 20 French Colonials, 2d. Postage extra.
Hagel Bros., 11, St. Clement's Avenue, Blackpool.

DO YOU COLLECT Fine Used British Colonials? Then ask to see my collection of 600 different at ½d. each Stamp, the best value at the lowest cost. Sent on request. A good selection at 1d. each and upwards if desired. Duplicate Stamps Bought or Exchanged.
BICKERS, Elveden, Lordswood Avenue, Southampton.

92,000
Well Assorted Used and Unused Stamps, clearing 1/- per 1,000 post free.
THE CENTRAL STAMP CLUB,
37, Bostock Road, Abingdon, Berks.

ENGLISH £1, 10/- & 5/- STAMPS
(Victoria, Edward, or George). These three stamps (issued and used for a special revenue purpose) with seven others, including one nearly **90 Years Old** and other **Old** English postage stamps **given away** free of charge to genuine applicants for selections of duplicate stamps on approval. 500 different (extra good). Post free, 1/6.
Henry Turner, 110, Barnet Road, Preston, Brighton, Sussex

STAMPS THAT ARE "DIFFERENT"
Do not miss these "Worth While" Offers
Add to the interest of your collection by including these latest issues, fine pictorial commemoratives, scarce Air Mails, etc. **The stamps with a story.**
Approvals if required.
Serious applicants for our WESTMINSTER BLUE BOOKS sending 2d. postage receive a fine commemorative set quite free.

NEW ISSUES AND NOVELTIES FOR THE JUNIOR AND MEDIUM COLLECTOR.

		All Mint.
New Guinea:	provisional Air Stamps, rare, 1d., 1½d. and 2d., Special Opportunity	8d.
Sudan:	set of 3 provisional Air Mails	1/3
	New pictorial Air Mails, set of 3	1/-
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Newfoundland:	15c. Air Stamp	10d.
Australia:	Kingsford-Smith, set of 3	1/9
Spain:	2c. optd. "Republica," scarce ...	1d.
Iraq:	new issue, set of 3	6d.
S. Rhodesia:	new issue, set of 3	6d.
Syria:	new issue pictorials, 6 values	4½d.
Latakia:	the first issue of a new State, optd. on Syria, set of 7	6d.
Andorra:	the Mountain Republic, 17 values, optd. on France. Don't miss these ...	1/6
India:	Delhi commems., set of 3	4d.
Gt. Lebanon or **Syria:**	½ pias Air Stamp ...	1d.

Ask for our new List of Sets, Packets, etc.
BARGAINS FOR EVERY ONE.
Postage Extra. **WESTMINSTER STAMP CO., 43, BUCKINGHAM GATE, LONDON, S.W.1.**

For further stamp advertisements, please see page 856.

Stamp Gossip

and Notes on New Issues

A Naval Air Stamp

The design of the recent Paraguayan air issue introduces the unusual feature of a war vessel as its central feature. This is the gunboat "*Paraguay*," and a group of three aeroplanes is shown flying over it.

The design illustrated is common to each of the five values in the series, 1p., 2p., 3p., 6p., and 10p. A further

interesting feature is the introduction of two date tablets, 1870-1930. The significance is a little obscure, but presumably the earlier date is to commemorate Paraguay's first issue of stamps in August, 1870. The Lion and Star surmounting the left and right side tablets are Paraguayan national symbols, of course.

The First Australian Air Mail

Those readers who possess flown covers from the first Australia-England air mail will be interested to know that a first price of 5/– has been fixed in the collectors' market. In view of the large quantity of mail carried—approximately 60,000 letters—it is doubtful whether the value will rise to any appreciable extent for some time to come.

Small quantities of mail from New Zealand, the Straits Settlements, and India also were carried, and it seems very likely that covers from these places will ultimately prove more valuable than those from Australia.

New Austrian Charity Series

An interesting Austrian issue that has been awaited with considerable interest is a charity series of stamps bearing portraits of Austrian poets. This issue is due to appear on 1st October. It comprises six stamps, their values being 10gr., 20gr., 30gr., 40gr., 50gr. and 1 sch. respectively, and each is being sold at double its face value.

Although Austria has no outstanding literary figures comparable with the musicians featured on the set issued in 1922, it is certain that the new issue will enjoy great popularity, for the standard of stamp production in Austria in post-war days has been high, particularly among charity and commemorative issues.

The Whitfield King 1932 Catalogue

The illustration of over 6,100 stamps and the listing of some 47,000 other issues in the compass of this handy pocket volume, less than one inch in thickness, is a triumph of the publishing and printing arts, but Messrs. Whitfield King deserve congratulation for more than the compactness of their new season's catalogue. Several new features have been introduced to add to the value of the production. The stronger and more serviceable binding used will appeal to all who use the catalogue extensively and who in the past have found that the attractively-coloured covers formerly used faded quickly. The use of a more opaque paper also will appeal as adding to the clarity of the illustrations.

The preface to the new edition reveals that 1,617 new stamps have appeared during the past year, a decrease of 39 on the previous year. Of the new stamps European countries issued 548. Africa comes next with 455, and then follow America with 347, Asia with 168, West Indies with 54 and Oceania with 45. The total number of stamps issued to date, as listed in the new catalogue, is 53,476, of which Europe claims 16,751, Africa 12,172, Asia 9,730, America 8,945, West Indies 3,212 and Oceania 2,666.

The presentation of the Whitfield King catalogue is carried out in so simple a manner that it is truly described as ideal for the young stamp collector. Further details are given in our advertisement pages or may be obtained on application to the publishers, Messrs. Whitfield King & Company, Stamp Importers, Ipswich. Readers should mention the "*M.M.*" when writing to the publishers.

Siam's Forthcoming Commemorative

In April next year Siam will celebrate the 150th anniversary of the foundation of the present reigning house, the Chakri Dynasty, and in commemoration a special series of eight stamps will be issued. The stamps are to appear on the 3rd or 4th of the month, coincident with the opening of a memorial bridge over the River Chao Phraya.

* * * *

It was recently announced that the profits of the United States Post Office bureau for philatelists for the past year amounted to no less than £65,000, an acceptable revenue item.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

Russian Airship Issue

We illustrate this month the 10K. stamp from the Russian airship construction series described in the August "*M.M.*"

The design shows a reindeer sleigh from the Tundra, a transport camel from the Steppes, in the central background a great factory, symbolising the coming industrial supremacy, and dominating all, silhouetted against the rays of light from the coming dawn of prosperity, is a mighty airship.

Russian stamp designers undoubtedly have succeeded in their efforts to support national propaganda. No other country has gone to the same lengths to make its stamps attractive.

* * * *

Australia's newly-acquired penchant for the issue of commemorative stamps is spreading to the countries under her administration. The Territory of New Guinea will celebrate the occasion of the tenth anniversary of Australia's mandated administration with a new set of stamps. These have a Bird of Paradise as the central feature of the design and they are inscribed with the dates 1921 and 1931.

* * * *

When faced with a stamp collecting problem, readers should write to the Editor for advice. He will gladly help them.

Stamp Collecting—(*Continued from page 841*)

commemorating the pioneer aeronautical work of Santos Dumont, provides an illustration of the early stages. In October, 1901, Santos Dumont flew his non-rigid airship *N6*, a tiny dirigible of 22,239 cubic feet capacity, equipped with a 12 h.p. motor, from St. Cloud to Paris and back in 30 minutes. Modern conditions are represented by the German *Graf Zeppelin*, which has many great flights to its credit. It has been illustrated on stamps very frequently and we choose our illustration from the United States 1930 issue used on mail carried to Europe by the *Graf Zeppelin* on its return from a flight to America. As a contrast to Dumont's *N6* it is interesting to record that the capacity of the *Graf Zeppelin* is 3¾ million cubic feet and its five engines develop a total of 2,650 horse power!

HORNBY SERIES

HORNBY ROLLING STOCK

GAUGE 0

Hornby Rolling Stock includes almost every type in use on the big railways, and a selection of the splendid range available is illustrated on this page. The various items are modelled on realistic lines, strongly built and beautifully enamelled.

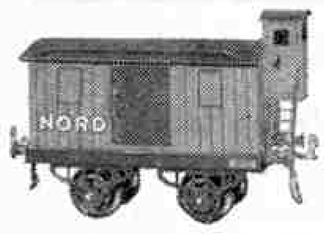
Ask your dealer to show you the full range of Hornby Rolling Stock.

OIL TANK WAGON "MOBILOIL"
Finished in battleship grey. Price **2/6**

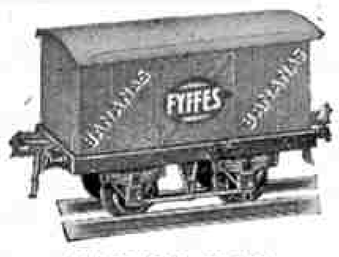
PETROL TANK WAGON "B.P."
Finished in yellow. Price **2/6**

PETROL TANK WAGON "SHELL"
Finished in red. Price **2/6**

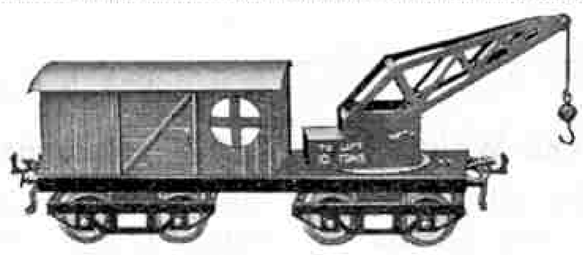
OIL TANK WAGON "CASTROL"
An attractive model. Enamelled green with lettering in red. Price **2/6**



BRAKE VAN (French Type)
Lettered "Nord." Beautifully finished in colours. Opening doors. Price **4/–**

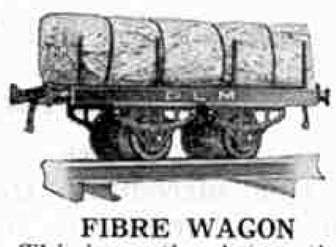


BANANA VAN
An attractive model, finished in yellow and green. Price **3/–**



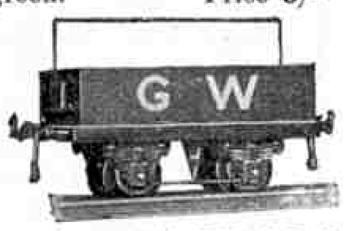
***BREAKDOWN VAN AND CRANE**
Beautifully coloured in brown and blue, with opening doors. Suitable for 2-ft. radius rails only. Price **6/3**

GUARD'S VAN
Realistic design, fitted each side with opening doors. Obtainable in L.N.E.R., L.M.S., G.W. or S.R. colours. Price **3/–**



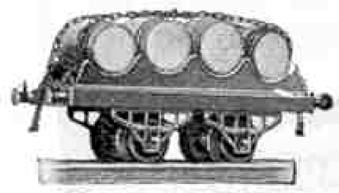
FIBRE WAGON
This is another interesting model of a type of wagon used in France and other European countries. Price **1/9**

MILK TRAFFIC VAN No. 1
Fitted with sliding doors. Complete with milk cans. Price **3/–**



OPEN WAGON "B"
Similar to Hornby Wagon No. 1 but fitted with centre tarpaulin supporting rail. Price **2/3**

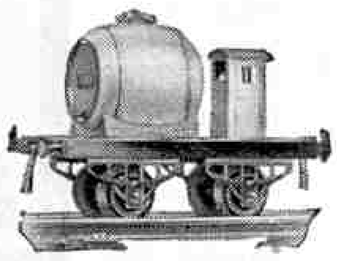
MITROPA COACH No. 3
Lettered "Mitropa" and either "Speisewagen" or "Schlafwagen" in gold. Beautifully finished in red enamel with white roof. Price **15/6**



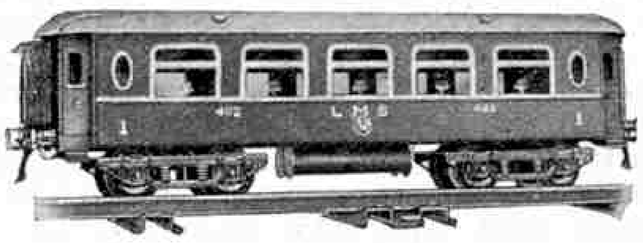
BARREL WAGON
This is an interesting model of a type of wagon used in France and other European countries. Price **2/9**

GAS CYLINDER WAGON
Finished in red, lettered gold. Price **2/6**

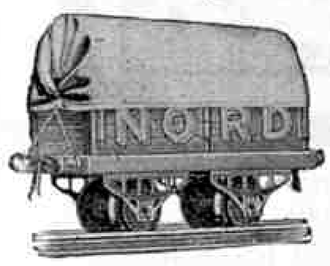
SIDE TIPPING WAGON
Excellent design and finish. Lettered "Robert Hudson Ltd." Price **2/6**



WINE WAGON, SINGLE BARREL
An interesting model of the single-barrel type of wine wagon used in France. Finished in red and green. Price **4/–**

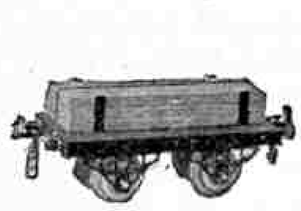


No. 2 SALOON COACH
Realistic in design and beautifully finished. Two types are available: L.M.S. (as illustrated) enamelled maroon, and L.N.E.R. enamelled brown. Suitable for 2-ft. radius rails only. Price **11/6**



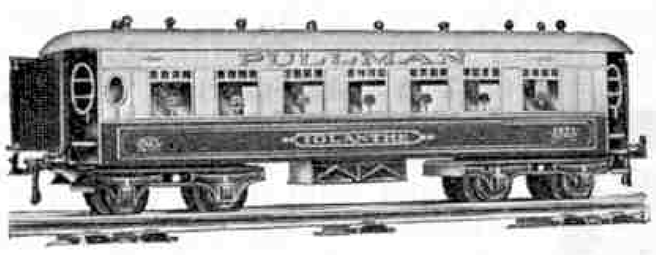
COVERED WAGON (French Type)
This wagon is fitted with frame and sheet. French type, lettered "Nord." Price **3/–**

ROTARY TIPPING WAGON
Finished in orange. Price **3/–**

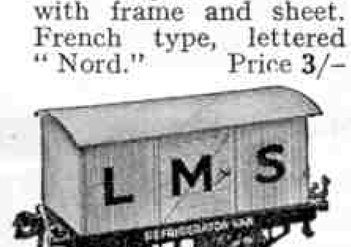


TIMBER WAGON No. 1
Beautifully enamelled in green and red. Price **1/9**

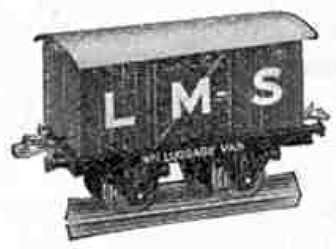
SNOW PLOUGH
With revolving plough driven from front axle. Price **5/6**



HORNBY No. 2 SPECIAL PULLMAN COACH
As supplied with No. 2 Special and No. 3 Pullman Train Sets. This splendid coach is perfect in detail and finish. Suitable for 2-ft. radius rails only. Price **15/–**



***REFRIGERATOR VAN**
Beautifully enamelled. Fitted with opening doors. Price **3/–**



***LUGGAGE VAN No. 1**
With opening doors. Price **3/–**

***GUNPOWDER VAN**
Finished in red. With opening doors. Price **3/–**

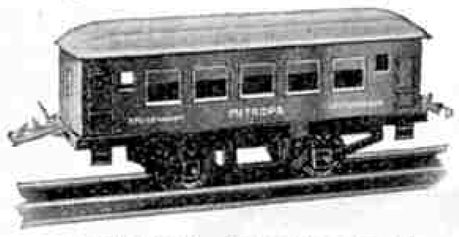
LUMBER WAGON No. 1
Fitted with bolsters and stanchions for log transport. Price **2/–**

TROLLEY WAGON
Finished in brown and blue. Suitable for 2-ft. radius rails only. Price **4/6**

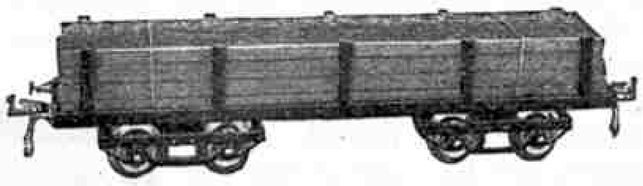
CRANE TRUCK
Finished in brown and blue. Price **3/6**

***HOPPER WAGON**
Mechanically unloaded. Finished in green. Price **3/6**

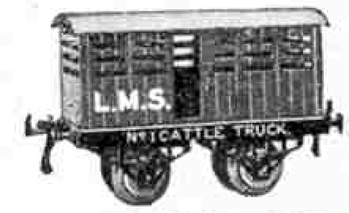
BITUMEN TANK WAGON "COLAS"
Finished in blue. Price **5/3**



MITROPA COACH No. 0
Finished in red with white roof. Lettered "Mitropa" and either "Speisewagen" or "Schlafwagen" in gold. Price **1/6**



TIMBER WAGON No. 2
Beautifully enamelled in green and red. Suitable for 2-ft. radius rails only. Price **3/6**



***CATTLE TRUCK No. 1**
Fitted with sliding doors. Very realistic design. Price **3/–**

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A very realistic model, finished in blue and white. Price **6/–**

JACOB'S BISCUIT VAN
Finished in crimson lake. With opening doors. Price **3/–**

COAL WAGON
This is similar to Hornby Wagon No. 1. It is fitted with embossed representation of coal. Price **2/3**

LUMBER WAGON No. 2
Fitted with bolsters and stanchions for log transport. Suitable for 2-ft. radius rails only. Price **4/–**

**In L.M.S., L.N.E.R., G.W. or S.R. lettering.*

CRAWFORD'S BISCUIT VAN
Finished in red. Opening doors. Price **3/–**

SECCOTINE VAN
Beautifully finished in blue. With opening doors. Price **3/–**

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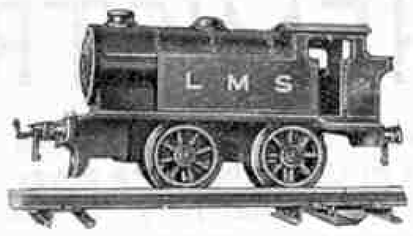
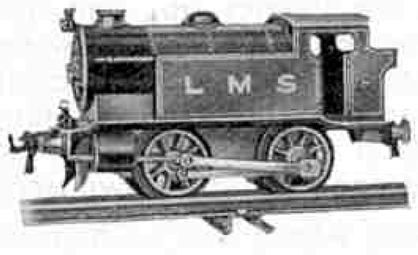
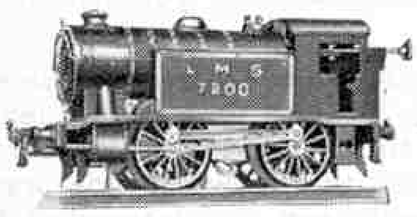
HORNBY TANK LOCOMOTIVES



M3 TANK LOCOMOTIVE. This is the powerful Locomotive (reversing) supplied with the new Hornby M3 Tank Goods Set. It is a handsome and extremely reliable model that will give long and excellent service. Available in either red or green. **Price, 7/6**

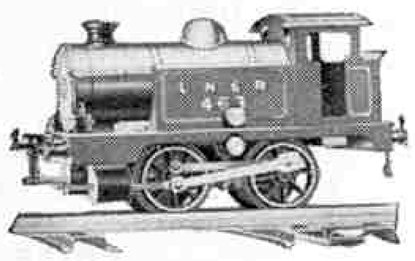
No. 1 TANK LOCOMOTIVE. This strong and durable Locomotive is capable of any amount of hard work. It is fitted with brake mechanism and reversing gear, and is supplied in colours to represent L.M.S.R., L.N.E.R., G.W.R. or S.R. Locomotives. **Price, 13/6**





No. 1 SPECIAL TANK LOCOMOTIVE. This splendid Locomotive which is fitted with brake mechanism and reversing gear, has remarkable power and gives a very long run. It is available in the colours of the L.M.S., L.N.E., G.W. and Southern Railways. **Price, 18/-**

No. 2 SPECIAL TANK LOCOMOTIVE. This Locomotive has great length of run and exceptional pulling power. It is fitted with brake mechanism and reversing gear. In every respect it is a perfect model, beautifully finished in the colours of the L.M.S., L.N.E., G.W. and Southern Railways. **Price, 25/-**



HORNBY No. 1 ELECTRIC TANK LOCOMOTIVE SET. This Electric Tank Locomotive is of the permanent magnet type, and may be run from a 6-volt accumulator. The unique feature is that it can be stopped, re-started, reversed and the speed varied by the operation of levers at the side of the track. It is supplied with a terminal connecting plate, speed and reverse control switch and 3 feet of flex, and it is available in the colours of the L.M.S., L.N.E., G.W., and Southern Railway Locomotives.

This Locomotive cannot be run from the mains supply. Price, 32/6

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How to Get More Fun—(*Continued from page 825*)

run to the Channel Islands, and to Birkenhead for Belfast and the Isle of Man; but the most familiar to "*M.M.*" readers are no doubt the Fishguard boat trains carrying traffic for Ireland. These traverse the famous Severn Tunnel—the longest under-water tunnel in the world—so that an interesting feature of a miniature system upon which such trains are run might well be a tunnel to represent this. For all these trains the use of Metropolitan Coaches would be reasonable, or alternatively Pullmans might be employed, as their colours are practically a replica of the G.W.R. coach livery. The Hornby G.W.R. No. 3 locomotive or the "*County of Bedford*" may be used for these trains, though in actual practice the latter engines are more particularly concerned with the Weymouth trains.

A great feature of the traffic dealt with at Fishguard is the amount of cattle shipped from Ireland. Special provision is made for them at the port and if space permits a miniature Fishguard might be similarly fitted. To carry this traffic, frequent specials composed of cattle wagons both of the No. 1 and No. 2 variety might be run, and in addition luggage and Milk Vans might be used to make up trains for dairy produce, which is conveyed in great quantities.

The followers of the Southern Railway are fortunate in that whatever section of that group their layout represents, Eastern, Western or Central, they may operate boat trains that have their counterparts in real practice. There are Dover Boat Trains, Southampton Boat Trains and Newhaven Boat Trains, so that the possible choice is a wide one. Chief of the Dover Continental trains is the famous "*Golden Arrow*," composed of Pullman cars and giving a splendid service from London to Paris in connection with the "Nord" express of the same name. Special provision has to be made in trains of this kind for carrying baggage. Therefore, in miniature in addition to a train of No. 2 Special Pullman coaches, a No. 2 Luggage Van may be coupled behind the engine and will look very realistic.

Pullman Cars are also used now on the Coach Liner expresses between Waterloo and Southampton Docks. Therefore Western Section enthusiasts who wish to be up to date should employ Hornby Pullmans on such train on their own systems.

Boat trains must of course be indicated for the guidance of the staff dealing with them, and this is an extremely fascinating feature when reproduced on a small scale. Train name boards are not hard to make, and in the case of the No. 2 Saloon and Pullmans they can be easily fixed to the roof. The board should be made of white card, and long enough to stretch between the brass ventilators which also secure the roofs. Tabs should be formed with the board and pierced so that the ventilators may be unscrewed, the board placed in position, and held in place by the refixed ventilators. If the boards are made 6 in. long and $\frac{1}{2}$ in. deep they will be big enough to accommodate even the longest titles. The tabs should be drawn out so that the hole pierced is $\frac{3}{8}$ in. away from the bottom of the board. The titles required may be written in Indian ink.

Collis Truck Model-Building Contest—

(*Continued from page 817*)

on a $3\frac{1}{2}$" Axle Rod journalled in the front of the chassis. The other end of the cord is attached to the end holes of two Boss Bell Cranks, which are secured about one inch apart on a $3\frac{1}{2}$" Axle Rod that is journalled two holes toward the rear of the chassis from the previously mentioned Rod. Directly above, and journalled in the lifting portion of the frame, is another $3\frac{1}{2}$" Rod, upon which are mounted two 1" Strips held in position by four Collars. These act as links.

A Set Screw, upon which is first placed a Washer, is passed through the other end hole of each Strip, and also through the other extremity in each Boss Bell Crank. It is then screwed into a Collar until it nips on a $6\frac{1}{2}$" Axle Rod, the end of which is inserted in the Collar. The other ends of the two $6\frac{1}{2}$" Rods are attached in the same manner to two more pairs of links at the rear of the truck, the bottom pair of which are spaced by Collars and mounted freely on the rear axle. The top pair of links are mounted on a 2" Axle Rod journalled in the lifting frame directly above the rear axle. The manner in which the hydraulic action operates when the steering handle is pulled downward will be quite obvious from a glance at the accompanying illustration.

G. H. Thomson, the winner of Second Prize in Section B, submitted a model of the Mechanical Truck. The model incorporates a neat foot pedal "catch," which locks the lifting frame in its raised position. The catch consists essentially of a pivoted $2\frac{1}{2}$" Strip fitted with a "barb" made from a $\frac{1}{2}$"$\times\frac{1}{2}$" Angle Bracket slightly bent. The barb engages a Girder Bracket bolted to the side of the lifting frame. A similar catch is used to hold the steering handle in its raised position when necessary.

The chief feature of G. Seiflows' Third Prize model is its simplicity of construction. This competitor also made a very creditable and successful attempt to reproduce the movements of the real Collis Truck.

A prize of 10/6 was awarded to Martin Orde for a model of the mechanical type truck. This competitor is not yet nine years of age and his success is therefore particularly noteworthy.

New Meccano Model—(*Continued from page 815*)

Strips are secured. Each hook is kept in the normal position by a piece of Spring Cord 12, one end of which is attached to the side plate and the other to a set-screw inserted in the boss of the 57-teeth Gear. Each piece of Spring Cord should be partially carried round the boss of the 57-teeth Gear before it is attached, so that its effort to come back to its normal state, and not its actual tension, is utilised to return the hooks.

The connecting links between the grab proper and the grab head are attached by lock-nutted bolts to the 1" Triangular Plates, and the hoisting cord 16 is secured to the cross member 1. The cord is then threaded through the round holes in the lower guide 4, and a large knot made in it in such a position that when the jaws are open the knot rests on top of the guide. The cord may then be passed through the upper guide 5 and through the $1\frac{1}{2}$" Pulley 15, which is termed the "suspender ring." This consists essentially of a $1\frac{1}{2}$" Pulley that is hung by two cords 17 from the jib head. These cords are each passed over the Pulleys 15 on the tower (Fig. 1, Sept. "*M.M.*") and over the outside pairs on the jib in exactly the same manner as that followed with regard to the hoisting cord, but the ends of the cords are attached to $1\frac{1}{2}$" Strips 17a at the top of the tower, and are not led down to a winch. A winch may be added if it is desired to effect discharge at different levels; otherwise it is only necessary to adjust the suspender to the most convenient height and then secure the ends of the cords to the Strips 17a.

The diagrammatic illustrations (Figs. 6, 7, 8) should help to make clear the operation of the grab. The grab should be assumed to be approaching the suspender with jaws closed (Fig. 6). In this position the hooks 7 (Fig. 5) are resting against the stops 6, the catch 9 is not touching the cord, and the knot is above the catch. The Pawls on the ends of the hooks are now forced over the rim of the suspender, thus allowing the catch to rise and bear against the hoisting rope.

Now if the latter is lowered, the weight of the grab is borne by the hooks and the jaws open. As the grab opens the knot passes to the underside of the catch 9.

To release the grab from the suspender, the hoisting rope is hauled in a little, thus causing the knot to bear against the underside of the catch. The latter bears, in turn, against the $\frac{3}{8}$" Bolt 8 (Fig. 9) and the arms of the hooks fall back on the stops 13. The grab is now freed from the suspender and it can be lowered in the open position (Fig. 8). On reaching the material to be removed, the hoisting rope is allowed to fall quite slack so as to give the weight of the Collar 16a a chance to pull the knot free from the catch.

We are indebted to Messrs. Stothert and Pitt, the makers of the actual crane for valuable technical assistance in connection with the building of the model.

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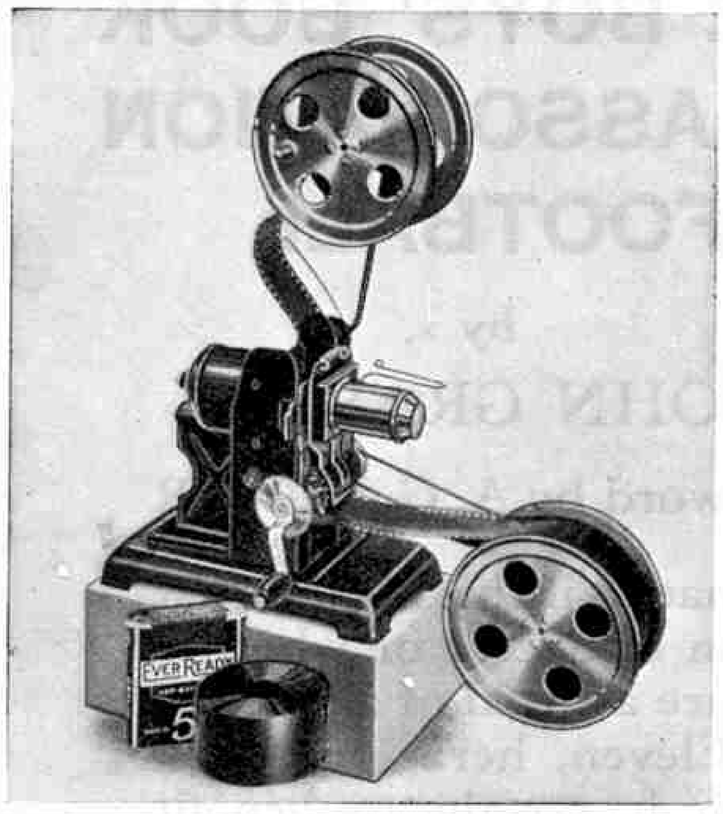

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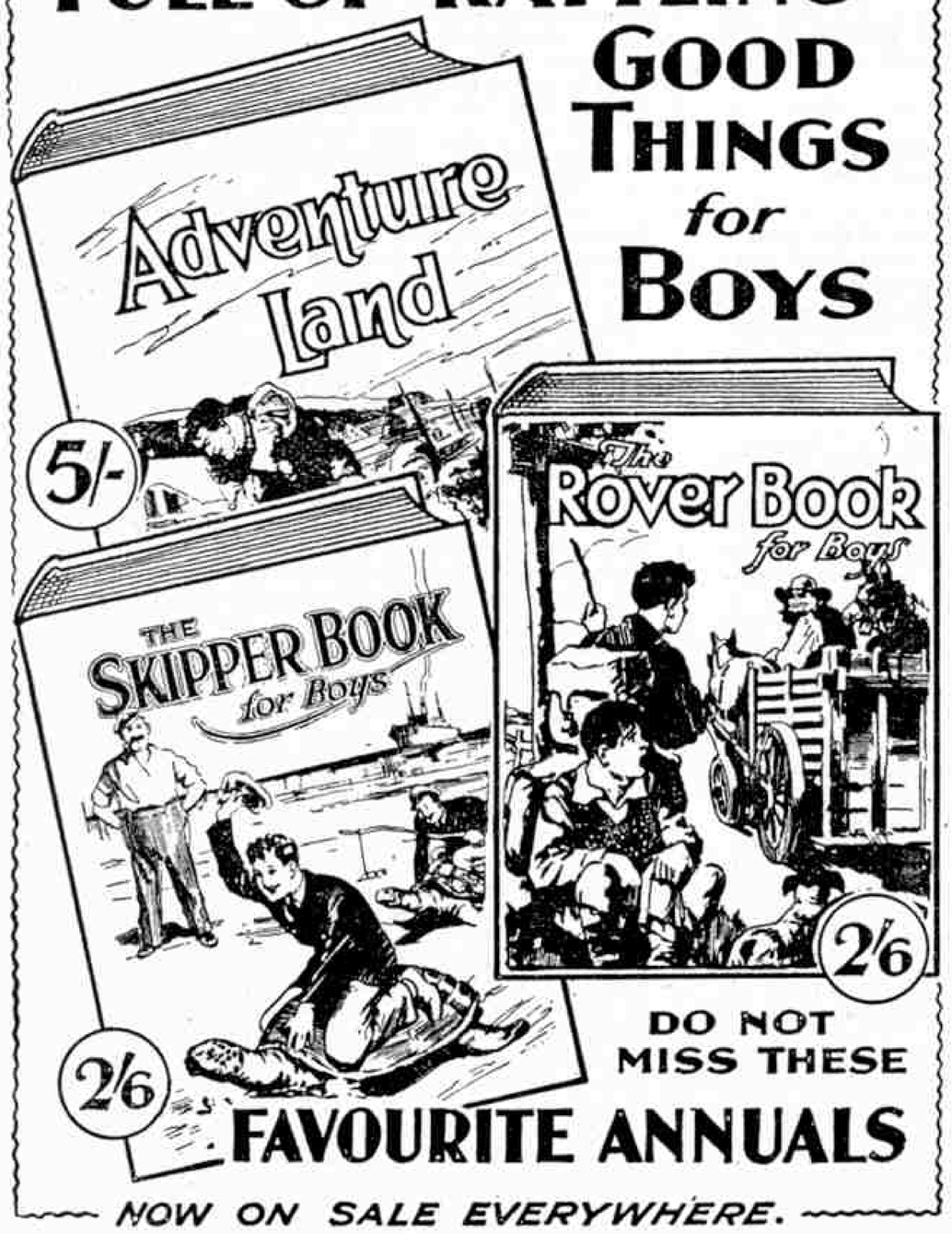

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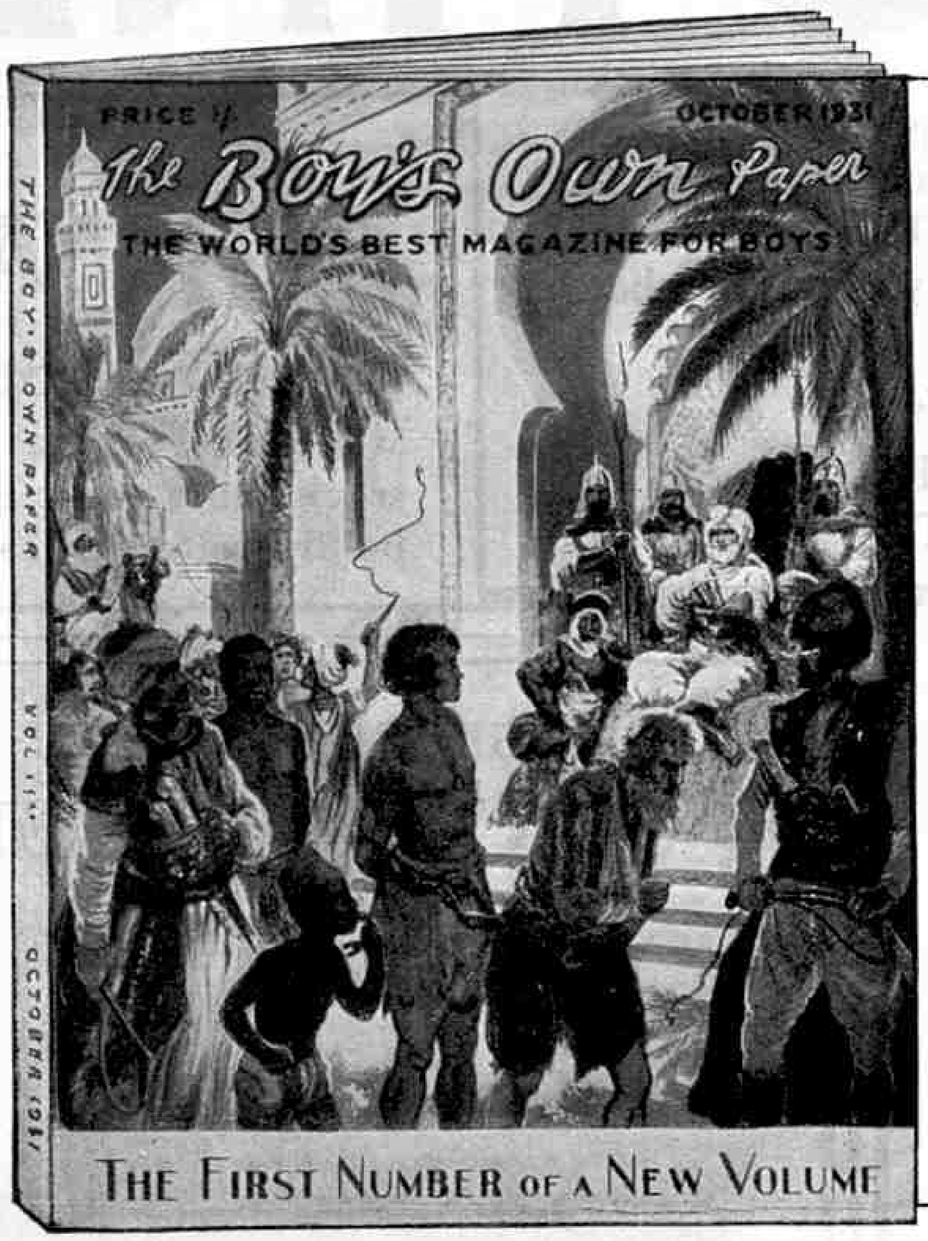

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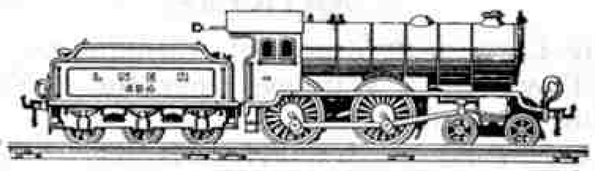

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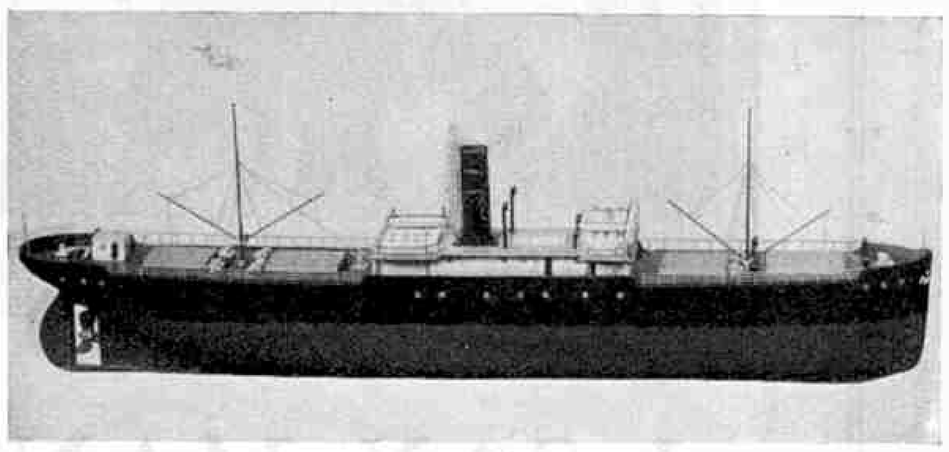

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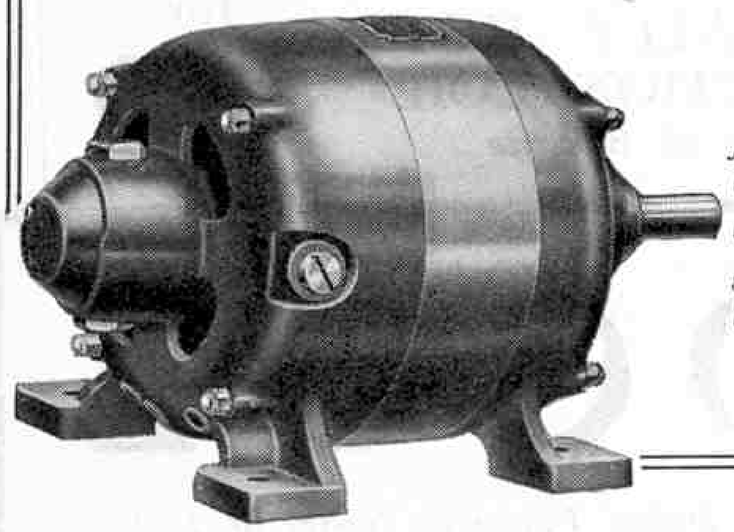

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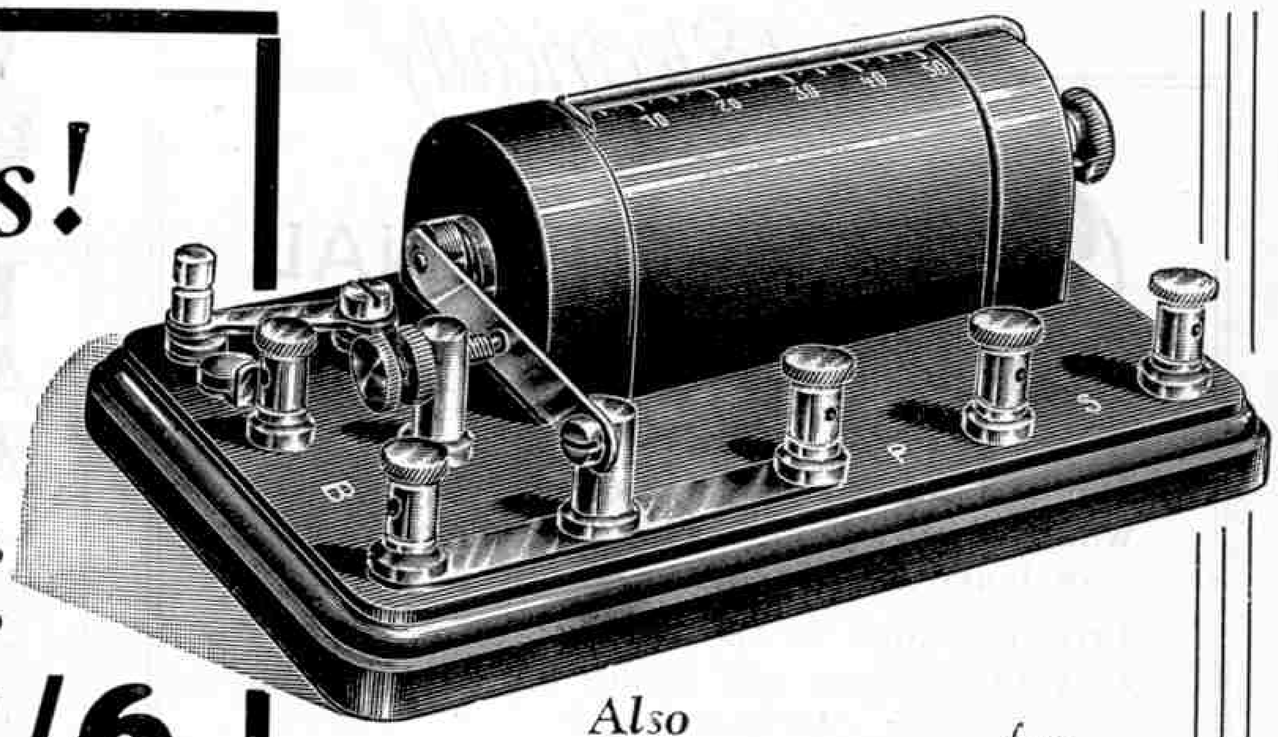

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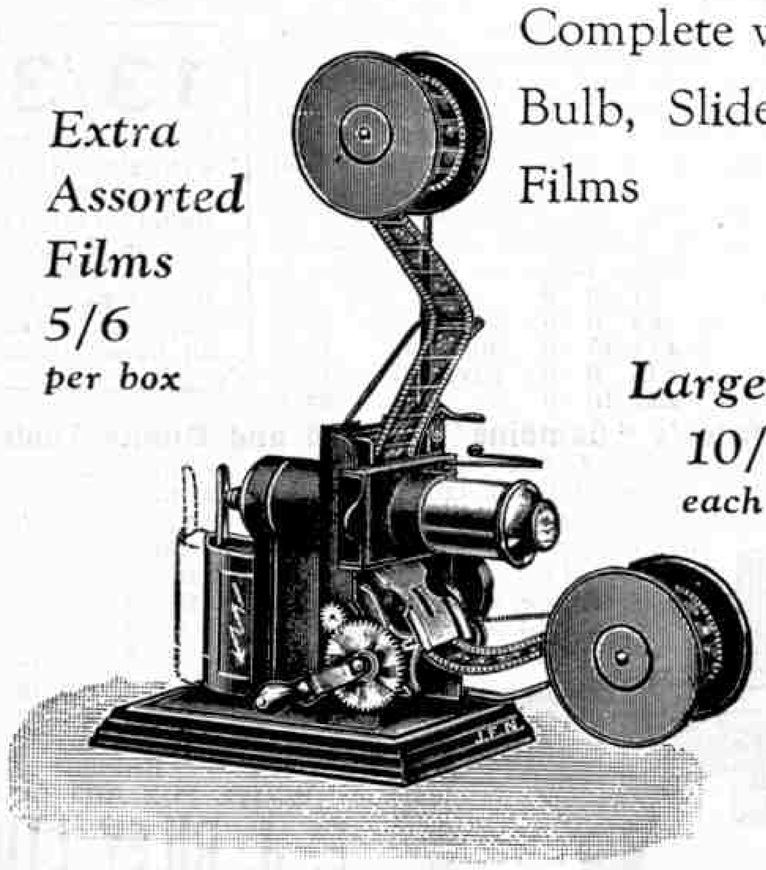

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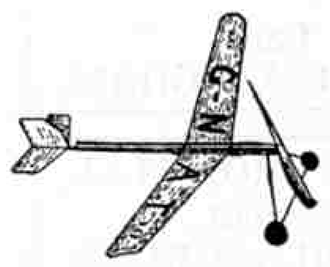

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Competition Results—

(*Continued from page 837*)

OVERSEAS

March Crossword Puzzle.—1. H. MACKAY (Morrinsville, N.Z.); 2. G. GRIFFIN (Willoughby, N.S.W.); 3. R. B. MCMILLAN (Melbourne); 4. R. L. MORTE (Roseville, N.S.W.). Consolation Prizes: Z. DE BEER (Rondebosch, Cape Town); H. R. BROOKES (Auckland, N.Z.); K. N. DRIVER (Poona, India); N. MCLEOD Auckland); MAC L. MORGAN (Cremorne, N.S.W.); C. F. B. WILDING-WHITE (St. Germain-en-Laye).

Ideal Career.—1. H. M. CAREY (Mowbray, Cape Town); 2. R. B. EVANS (Montreal); 3. M. ROBINSON (Cape Town); 4. B. C. KHUMBATTA (Broach, ndia). Consolation Prize: K. N. DRIVER (Poona, India).

My Favourite Competition.—First Prizes: Section A, R. GARCIA (Port of Spain, Trinidad); Section B, J. A. RODRIGUEZ (Montreal). Second Prizes: Section A, N. GUDMANZ (Elliot, Cape Province); Section B, M. FRANKEL (Muizenberg, Cape Town). Consolation Prizes: W. RUSSELL (Whangarei, N.Z.); A. TOLEDANO (Rio de Janeiro).

Built Words.—1. H. C. KEY (Calcutta); 2. D. R. SMITHSON (Boksburg, Transvaal); 3. D. YOUNG (Amatikulu, Zululand); 4. J. S. DE'CONTI MANDUCA (Sliema, Malta). Consolation Prizes: E. R. FUSSLEIN (Mtunzini, Zululand); R. GLEED (Vancouver Island); C. A. LASKARIS (Athens); S. D. Low (Mowbray, Cape Peninsula); D. B. RAY (Johannesburg); K. TAIT (Salisbury, S. Rhodesia).

April Photo Contest.—First Prizes: Section A, C. J. MCCAIN (Sydney, N.S.W.); Section B, W. T. LOKE (Clarens); Second Prizes: Section A, AMANULLAH C., (Karachi); Section B, S. LEVY (Stamboul). Consolation Prizes: L. CLARKE (Auckland, N.Z.); J. CREDIE (Cape Town).

32nd Drawing Contest.—First Prizes: Section A, J. B. BEAVON (Wellington, N.Z.); Section B, A. MCKELLAR (Johannesburg, S.A.); Second Prizes: Section A, A. C. F. BECK (Rotterdam); Section B, M. LESTER (Taranaki, N.Z.); Consolation Prizes: A. DANEEL (Transvaal); L. G. EUSTRATIADI (Istambul); J. FROUD (Toronto); G. JEFFREY (Moose Jaw); R. LISTER (Red Deer, Alta.); E. WASSON (Havelock, Canada).

Results of Model-Building Contests—

(*Continued from page 819*)

The length of the actual Rail Car is 80 ft. and C. Kauffman, the builder of this interesting model, has tried to construct it as nearly as possible to scale.

It is very pleasing to see Meccanoites keeping abreast of the times by using their Outfits to reproduce the latest engineering developments.

The Third Prize model represents the Cierva Autogiro, and was sent in by L. A. Laker. Its construction is so plainly shown in the accompanying illustration as to render unnecessary any further description.

First Prize in the Section devoted to No. 1 Outfit models was awarded for an interesting little model of a Bag Hoist, sent in by James Wilson. It consists mainly of four 4½" Strips mounted by means of Angle Brackets one at each corner of a 5½" × 2½" Flanged Plate, which serves as a base. The four Strips support the hoisting mechanism, which consists of a complicated arrangement of Pulleys round which the hoisting cord passes before being attached to a Crank Handle journalled in holes near the lower ends of a pair of the 12½" Strips, and by which the hoist is operated.

P. C. Carter won Second Prize with a model crane, the base of which consists of a 5½" × 2½" Flanged Plate. The superstructure is mounted on a 3" Pulley, to which two Trunnions are bolted to provide supports for two 12½" Strips forming the jib. The jib is rotated by means of a Bush Wheel mounted at the rear of the Flanged Plate and to which a length of cord is attached. The cord is then passed round the 3" Pulley on which the jib is mounted, and the other end of the string is then attached to another hole in the Bush Wheel. On turning the Bush Wheel the string acts as a belt and swivels the jib.

Third Prize also was awarded for a model crane, constructed by F. Croydon. The jib is made up of 4½" Strips, and the crane hook is raised and lowered by turning a handle consisting of a Bush Wheel, in one hole of which a bolt is secured to form a handle.

Result of the Fifth "Lynx-Eye" Contest

The following are the awards in the Fifth " Lynx-Eye " Contest :—

Section A (for competitors living in the British Isles). First Prize, £1-1s.: F. O'CONNELL, Walton, Liverpool. Second Prize, 15/-: E. BRADSHAW, Sheffield. Third Prize, 10/6: G. MARSH, Blackpool. Twelve Prizes of " *Famous Trains* " by C. J. Allen: H. MCMILLAN, Baschurch, Shrewsbury; J. C. PROSSER-FRENCH, Tonbridge; G. TAYLOR, Nottingham; L. BOSTON, Paddington, London; P. ROGERS, Blackburn; W. JONES, West Ham; L. HEDGER, Newcastle-on-Tyne; W. RIDGEWAY, Leeds; P. TOMPKINS, Newcastle; D. JONES, Llandudno; A. ROBINSON, Chesterfield; O. JONES, Cardiff.

Section B (for competitors living Overseas). First Prize, £1-1s.: Miss C. GONSALVES, Bombay, India. Second Prize, 15/-: C. SHARPE, Nelson, N.Z. Third Prize, 10/6: A. KHAN, Karachi, India. Twelve Prizes of " *Famous Trains* " by C. J. Allen: J. GOMES, Bandra, Bombay; J. GNANADURAI, Trichinopoly; B. A. ROMESH, Jubbalpore; B. THOMAS, Brisbane; J. WILLIAMS, Cape Town; T. CHANG, Singapore; O. PHILLIPS, Toronto; N. PINCHO, Gibraltar; P. BABAJEE, Lucknow; P. HAMID, Bombay; R. WELSH, Colombo; P. FARNWORTH, Wellington, N.Z.

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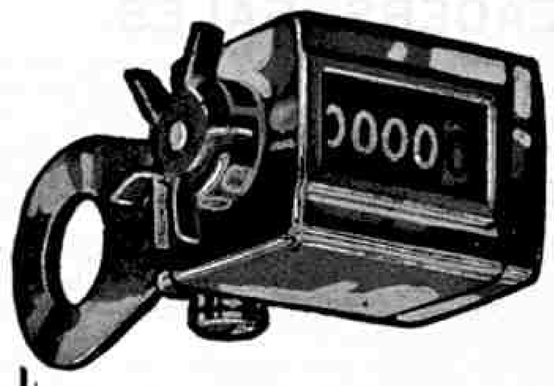

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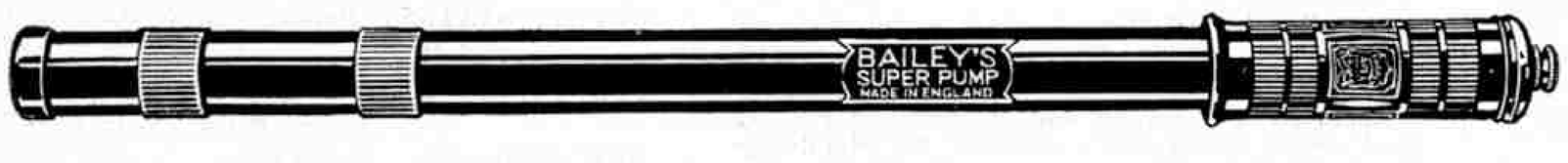

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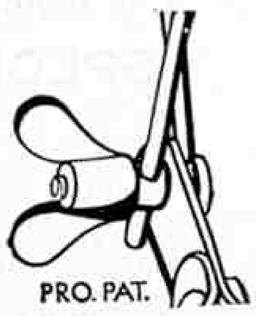

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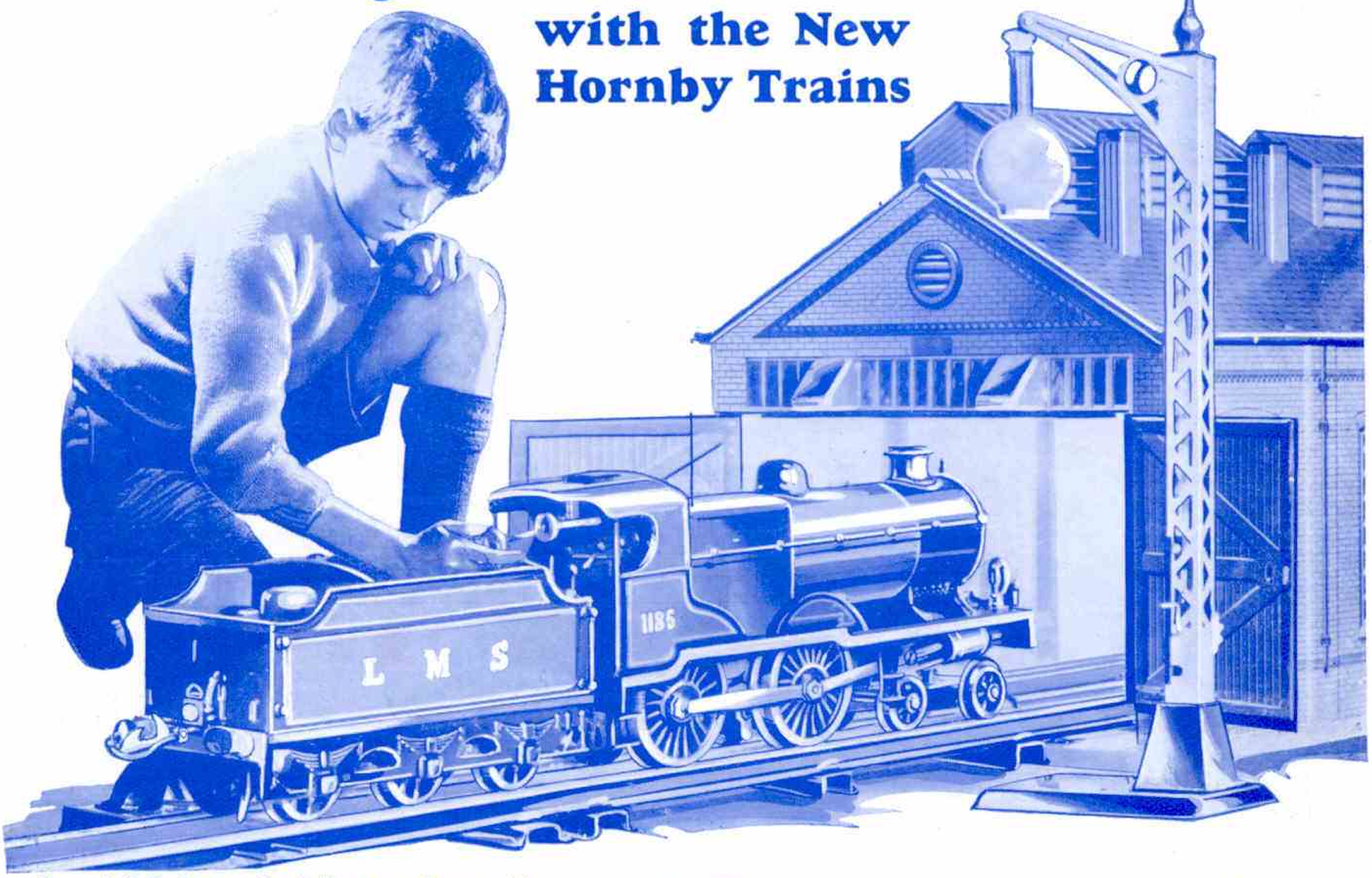
Still Longer Runs—Still Heavier Loads with the New Hornby Trains



Boys, tell Dad **now** about the present you wish him to give you at Christmas. Tell him you want a Hornby Train Set. If he asks why, tell him that—

Hornby Trains give longer runs and haul heavier loads.

They are strong and reliable.

They are realistic and one hundred per cent efficient.

They are beautifully finished in correct colours.

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M0 Passenger Set	5/9	No. 1 Passenger Set	28/6
M1 Passenger Set	9/3	No. 1 Special Goods Set	32/6
M1 Goods Set	10/–	No. 1 Special Passenger Set	35/–
M2 Passenger Set	10/9	No. 2 Mixed Goods Set	40/–
M3 Tank Goods Set	15/–	Metropolitan Train Set C	45/–
No. 0 Goods Set	18/6	No. 3C Train Set Riviera "Blue"	62/6
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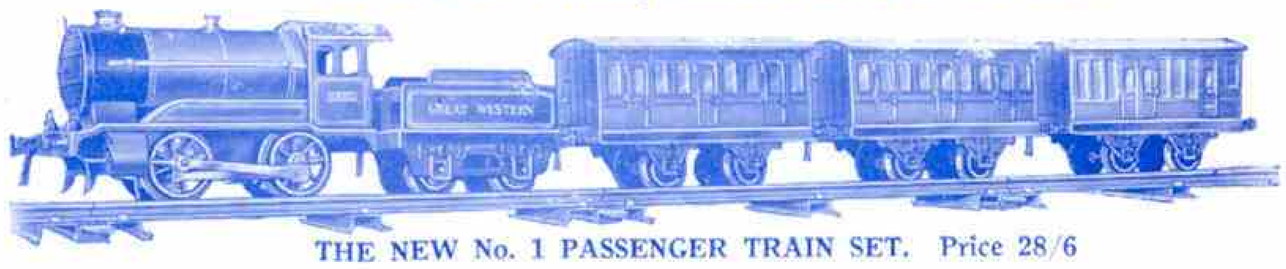

THE NEW No. 1 PASSENGER TRAIN SET. Price 28/6

HORNBY TRAINS

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A NEW DEVELOPMENT IN

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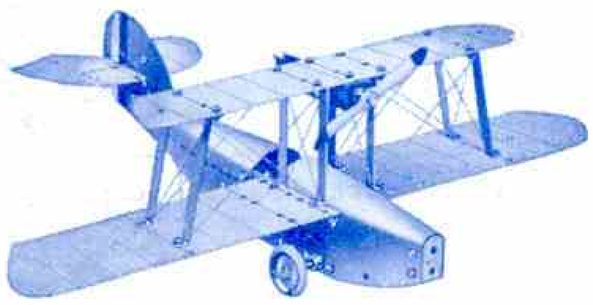

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Old Swan, Liverpool

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